A star (✱) indicates that the Abstract deals with Apparatus and Instruments.

DECEMBER, 1940.

GENERAL PHYSICS.

ATOMIC AND MOLECULAR STRUCTURE.

3053. Electrostatic dipole moment of a nucleus in the meson theory. S. T. MA. *Cambridge Phil. Soc., Proc.*, **36,** *pp.* 438–440, *Oct.*, 1940.—The interaction between a scalar potential and a nucleus, including its exchange meson field, is investigated. The conclusion is reached that an external field which can be described by a vector potential interacts only with the proton as far as electric dipole interaction is concerned. There is also an electrostatic dipole moment due to the emission and absorption of a meson which interacts with an electrostatic field. A. J. M.

3054. Deviation from the Coulomb law for the proton. S. T. MA. *Cambridge Phil. Soc., Proc.*, **36,** *pp.* 441–445, *Oct.*, 1940.—Recent work on the meson theory has led to the result that the Coulomb attraction between the proton (assumed to be surrounded by a meson field) and a negative point charge changes into a strong repulsion for distances less than 1/6th of the electronic radius. The experimentally observed effect is, however, much smaller than this theory predicts. The more recent theory of Heitler, that a nuclear particle has a number of states higher than the normal neutron and the normal proton states, is applied to the problem, and it is shown that the deviation from the Coulomb law comes out much less than that previously calculated and more in accord with experimental results. A. J. M.

3055. Carbon isotopes of mass 10 and 11. L. A. DELSASSO, M. G. WHITE, W. BARKAS AND E. C. CREUTZ. *Phys. Rev.*, **58,** *pp.* 586–590, *Oct.* 1, 1940.—C^{11} has been produced by 2 new reactions: namely, $B^{11}(p,n)C^{11}$ and $N^{14}(p,\alpha)C^{11}$. The upper limit of the positron spectrum of C^{11} has been measured in a cloud chamber and the value $0 \cdot 95 \pm 0 \cdot 03$ eMV obtained. A new isotope, C^{10}, has been produced by the reaction $B^{10}(p,n)C^{10}$. This nucleus has a disintegration period of $8 \cdot 8 \pm 0 \cdot 8$ sec. The upper limit of the positron spectrum was found to be $3 \cdot 36 \pm 0 \cdot 1$ eMV. A discussion is given of the relation which these measurements bear to the isobaric splitting and systematic properties of light nuclei. AUTHORS.

3056. Optical methods for study of molecular structure. *J.O.S.A.*, **30,** *pp.* 369–404, *Sept.*, 1940.—A symposium containing the following papers: The X-ray diffraction method, by B. E. Warren (*pp.* 369–373); the electronic diffraction method, by L. R. Maxwell (*pp.* 374–395); the Raman spectra method, by G. M. Murphy (*pp.* 396–404).

3057. Electron diffraction investigation of the structure of propylene bromide. V. SCHOMAKER AND D. P. STEVENSON. *Am. Chem. Soc., J.*, **62,** *pp.* 2423–2425, *Sept.*, 1940.—[See Abstract 4 (1940).] From electron diffraction photographs of propylene bromide it has been found that C–Br $= 1 \cdot 92 \pm 0 \cdot 02$ Å, $\angle$ C–C–Br $= 110 \pm 1°$ and that the molecule has a "trans" configuration with respect to the Br atoms. The appearance of the photographs may be interpreted on the assumption that the molecule is essentially rigid except for a torsional oscillation with an amplitude of about 20°. AUTHORS.

See also Abstract 3183.

COLLOIDS.

3058. Abnormal series of colloidal solutions produced by electrolytes. N. Sata and S. Ito. *Chem. Soc. Japan, Bull.*, **15**, *pp.* 271–275, *July*, 1940. *In German.*—The abnormal state for mastic-sol produced by ferric chloride no longer exhibits irregularity when purified by dialysis for 20 days, although it is not then reproduced by addition of those electrolytes which were found in the outer liquids during dialysis. Irregularity is, however, produced by addition of the ethyl alcohol used as solvent; methyl alcohol and acetone achieve a like result. It has been established that not only active electrolytes but also the surface properties of the colloidal particles play an important rôle in the production of an abnormal colloidal solution. H. H. Ho.

***3059. Determination of the distribution of crystallites in fibres by direct and indirect methods.** Y. Go. *Chem. Soc. Japan, Bull.*, **15**, *pp.* 239–258, *July*, 1940. *In German.*—The use of the diatropic X-ray reflector for the determination of crystallite distribution in a fibre affords the advantage that this distribution may be measured directly. Apparatus details are given which include a new type of camera with moving film. By means of this camera other experiments for the direct determination of crystallite distribution are described, while further possible applications are discussed. Indirect determination processes, which require mathematical computation of data based on different principles of derivation, have been collated and compared, and their data tested by comparison with the experimental values now found by the direct method. The formula derived from principles worked out by Kratky [Abstract 4315 (1933)] and Matano [*J. Soc. Chem. Ind. Japan*, **39**, 478, 1936] thereby appears to possess the greatest validity. H. H. Ho.

3060. Technical quantitative analysis of a textile fibre. C. Casassovici, D. Teodorescu and I. Ionescu-Muscel. *Bull. Soc. Roumaine de Physique*, **41, 75**, *pp.* 5–16, 1940. *In German.*—The authors describe a method for obtaining the degree of uniformity of the textile materials which constitute a thread, by measuring the uniformity and the resilience of the threads which are submitted to a tension in the direction of their length. Authors.

See also Abstract 3219.

CRYSTAL STRUCTURE AND SPECIAL PROPERTIES.

3061. Crystallization relationships of a soda-lime-magnesia-silica glass as used for drawn sheet and the process of devitrification. E. Preston. *Soc. Glass Technol., J.*, **24**, *pp.* 139–158, *Aug.*, 1940.—The gradient method has been employed for the investigation of the crystallization-temperature-time relationships of a sheet glass of percentage composition 72·15 SiO_2, 2·02 R_2O_3, 8·91 CaO, 2·05 MgO, 13·58 Na_2O, 0·73 K_2O and 0·04 SO_3. The liquidus temperature was found to be 965° and the binary eutectic temperature 850°. The formation of the ternary eutectic was not observed. The temperature of maximum crystal growth was 910°. Examples are given illustrating the rate of crystal growth at different temperatures, the effect of time on crystallization and the separation of the binary eutectic of devitrite and silica. The shape of the crystallization/temperature curve is considered in relation to the equilibrium diagram and to the viscosity of the glass. It is shown that, to a first approximation, above the temperature of maximum crystal growth, crystallization is proportional to the temperature interval below the liquidus temperature ; and, below the temperature of maximum crystal growth crystallization is inversely proportional to the viscosity. The early stages of crystallization can be represented by an equation of the type:—$r = Ce^{-A/T_{\mathrm{Abs.}}}(T_{\mathrm{Liq.}} - T)$. in which r is the rate of crystal growth and A is a constant deduced from the viscosity/temperature relationship of the glass. The process of devitrification is discussed from the viewpoint of the equilibrium diagram of the soda-lime-silica system by the aid of a perspective drawing of a portion of the equilibrium model relevant to commercial glass compositions. Correlation of the results obtained on commercial soda-lime-silica glasses with the known equilibria conditions for the pure glasses would ultimately lead to a representation of the effects of minor constituents on the crystallization properties of such glasses. A plea is made that more attention should be given to this subject by all glass technologists. AUTHOR.

See also Abstracts 3158, 3169, 3171, 3179, 3228.

DENSITY.

3062. Density of silicate glasses as a function of composition. M. L. HUGGINS. *Kodak Research Lab., Comm. No.* 769. *J.O.S.A.*, **30,** *pp.* 420–430, *Sept.*, 1940.—The volume per gm. atom of O in a well-annealed silicate glass is given quite accurately by the equation $Vo = k + b_{\mathrm{Si}} + c_{\mathrm{Si}} N_{\mathrm{Si}} + \Sigma c_{\mathrm{M}} N_{\mathrm{M}}$, where k is a very small constant characteristic of the annealing technique, N_{Si} and N_{M} are the numbers of Si or other " metal " atoms per atom of O, b_{Si} and c_{Si} are constants which are different for different ranges of N_{Si} values, and c_{M} are constants valid (in so far as can be determined from present data) for all values of N_{M}. For boron-containing glasses separate terms are required for tetrahedrally surrounded and for triangularly surrounded atoms, the relative numbers of which depend on the relative amounts of Si, B and O. With the aid of the above equation, densities from compositions can be calculated. The empirical results obtained are interpreted theoretically. AUTHOR.

See also Abstract 3081.

DIFFUSION AND OSMOSIS.

3063. Theory of diffusion, viscosity and electrolytic conduction. S. KANEKO. *Chem. Soc. Japan, Bull.*, **15,** *pp.* 276–280, *July*, 1940.—The phenomena of diffusion and viscosity are very intimately connected with electrolytic conduction, and in this mathematical paper all 3 are treated as examples of the theory of reaction velocity. The results obtained are of a rather qualitative nature and require further development. H. H. Ho.

3064. Confirmation of the theory of thermal diffusion. T. I. TAYLOR AND G. GLOCKLER. *J. Chem. Phys.*, **8,** *pp.* 843–844, *Oct.*, 1940.

ELASTICITY AND PLASTICITY.

3065. Research on combined stress and anisotropy. J. J. GUEST. *Phil. Mag.*, **30,** *pp.* 349–369, *Nov.*, 1940.—This paper discusses the effect of departure from isotropism in the specimen on the yield point under various stress combinations and analyses the experimental results and deductions drawn therefrom given in papers by Mason, Becker and Cook. For ascertaining the effects of the simple forms of anisotropy which manufacture tends to leave in the product, it is assumed that the primary factor in elastic failure is the maximum shearing stress. The application of these deductions to the researches referred to show that, for close correlation, an effect due to volumetric stress must be included, and that the various unexplained difficulties encountered in these researches are then completely clarified and all the results are shown to be in close agreement with the Guest criterion of elastic failure. AUTHOR.

3066. Theory of elasticity of non-isotropic materials (with applications to problems of bending and torsion). E. REISSNER. *Phil. Mag.*, **30,** *pp.* 418–427, *Nov.*, 1940.—This paper contains a contribution to the 2-dimensional theory of elasticity of materials of rectilinear anisotropy. The theory and its applications presented are very much simpler than the corresponding developments for isotropic materials. The simplification is due to the fact that 1 of the 2 moduli of elasticity which occur in plane stress is assumed equal to zero, which means that the material is not resistant to normal stresses in a certain direction. A material for which these assumptions are very nearly true is a corrugated sheet in which pitch and depth of the corrugations are small compared with the overall dimensions of the sheet. AUTHOR.

3067. Young's modulus of diamond. P. R. PISHAROTY. *Indian Acad. Sci., Proc. A*, **12,** *pp.* 208–211, *Aug.*, 1940.—It is shown that the section of the elastic surface of a cubic crystal by an octahedral plane is a circle. Voigt's "scale and telescope" method for determination of Young's modulus of crystals is improved by the use of a narrow slit and a long-focus camera, the shift being recorded photographically and measured by a Hilger micrometer. The experimental value of Young's modulus of diamond in any direction lying in the octahedral plane is found to be $5 \cdot 5 \times 10^{12}$ dynes/cm^2. The maximum value for a cubic crystal being in a direction normal to this plane, a higher value for a rod cut normal to the octahedral plane may be expected. AUTHOR.

See also Abstract 3179.

HYDRODYNAMICS AND AERODYNAMICS.

3068. Application of the similarity theory of turbulence to the flow through a straight pipe of annular cross-section. S. TOMOTIKA, K. TAMADA AND Y. SAITO. *Tokyo Univ. Aeronaut. Research Inst., Report, No.* 188, *pp.* 29–60, *March*, 1940.—It is found that the shearing-stress theory gives fairly good agreement with experiment over the whole range in both the inner and outer parts of the pipe, except near the walls. The results of the momentum theory give poor agreement with observation. W. A. R.

3069. Application of the momentum transport theory to the turbulent flow through a straight pipe of annular cross-section. S. TOMOTIKA AND H. UMEMOTO. *Tokyo Univ. Aeronaut. Research Inst., Report No.* 189, *pp.* 63–76, *May*, 1940.—The results obtained on the modified vorticity transport theory are in better agreement with observation than those calculated on the momentum transport theory. W. A. R.

3070. Application of the vorticity transport theory to the turbulent flow through a straight pipe of annular cross-section. S. TOMOTIKA AND K. TAMADA. *Tokyo Univ. Aeronaut. Research Inst., Report, No.* 190, *pp.* 79–95, *May*, 1940.—The vorticity transport theory with symmetrical turbulence is in better agreement with observation than the results of the modified vorticity transport theory or those of the momentum transport theory. W. A. R.

3071. Resistance to the uniform motion of a solid through a viscous liquid. R. B. Block. *J. of Applied Physics*, **11**, *pp*. 635–642, *Oct.*, 1940.—The apparatus was a straight, closed glass tube containing a steel ball and the liquid being studied. The tube was arranged so that it could be inclined at various angles with the horizontal, and the only motion of the ball that was considered was one of pure rolling. The liquids employed were mixtures of glycerine and methyl alcohol. The analysis of the data is based upon Stokes's and Oseen's forms of Rayleigh's law of resistance, and the results of the investigation are interpreted in the light of theories due to Basset and to Brillié. The results appear to indicate that the liquid slipped on the surface of the solid.

KINETIC THEORY OF MATTER.

3072. Physical and astronomical information concerning particles of the order of magnitude of the wavelength of light. F. Ehrenhaft. *Frank. Inst., J.*, **230**, *pp*. 381–393, *Sept.*, 1940.—Experiments on the motions of small particles floating in gases and liquids under the action of powerful beams of light combined with electric and magnetic fields are referred to. The author claims that these experiments lead to the conclusions (1) that electric charges smaller than that of the electron are possible; (2) that radiation pressure may exert an attraction as well as a repulsion on matter, and (3) that an intense beam of light makes material particles move either way along the lines of force of a homogeneous magnetic field as if the particles were single magnetic north or south poles. The solar corona, it is suggested, may be due to the latter effect. G. C. McV.

MATHEMATICAL METHODS AND THEORY OF MEASUREMENTS.

3073. Meaning of the symmetric correlation coefficient between vector sets. M. Masuyama. *Phys. Math. Soc., Japan, Proc.*, **22**, *pp*. 579–585, *July*, 1940.—The s.c. coefficient has been previously introduced. [Abstract 629 (1940).] The author here discusses its absolute meaning in connection with the generalized Fourier coefficient. S. A. S.

MECHANICS, QUANTUM.

3074. Maxwell's and Dirac's equations in the expanding universe. E. Schrödinger. *Roy. Irish Acad., Proc. A*, **46**, 4, *pp*. 25–47, *May*, 1940. —Maxwell's first-order equations are investigated, and the analysis of the Dirac equations is extended to the non-static case. A. J. M.

3075. Electron velocity distribution in the planetary nebulae. Y. Hagihara. *Roy. Astron. Soc., M.N.*, **100**, *pp*. 631–634, *June*, 1940.—A planetary nebula consisting of hydrogen alone is considered and it is proved that a steady state exists in which the frequency function for the electron velocities for each value of the radiation frequency does not correspond to a Maxwellian state. The electron velocity distribution deviates from the Maxwellian for nebulae in radiative equilibrium when the optical thickness is sufficiently small. G. C. McV.

3076. Quaternion analogy of wave-tensor calculus. W. H. McCrea. *Phil. Mag.*, **30**, *pp*. 261–281, *Oct.*, 1940.—Eddington's form of the quantum theory is based on a calculus of E-numbers which has some analogy with the simpler calculus of quaternions. This analogy is traced out in detail. G. C. McV.

3077. Distribution function of a simple liquid model. J. CORNER. *Phys. Soc., Proc.*, **52,** *pp.* 764–767, *Nov.*, 1940.—A discussion of the distribution function with reference to the work of various investigators. A simplified formula has been found and plottings of distribution function curves are given and discussed. N. M. B.

See also Abstract 3098.

PRESSURE.

See Abstract 3110.

RELATIVITY AND ETHER.

3078. Idea of minimum proper time, and some consequences of it. M. FAHMY. *Phil. Mag.*, **30,** *pp.* 331–339, *Oct.*, 1940.—The unified field theory in which the track of an electron is a null-geodesic in a 5-dimensional manifold is discussed. It is assumed that the electromagnetic potentials have their classical values and that, therefore, electromagnetic energy produces no curvature in the manifold. With this limitation, it is shown that the proper time of an electron occurs in multiples of h/mc^2, m being the mass of the electron. For an electron moving around a charged nucleus, the theory shows that the electron's minimum distance from the nucleus is the electron radius. It may also be shown that the maximum number of chemical elements is 97. G. C. McV.

See also Abstracts **3076, 3091.**

SOLUTION.

3079. Solubility of certain elements in copper and in silver. E. A. OWEN AND V. W. ROWLANDS. *Inst. of Metals, J.*, **66,** *pp.* 361–378, *Oct.*, 1940.—The paper contains an account of the determination, by the X-ray method, of the solubilities at different temperatures of the elements Zn, Ga, Ge and As, in Cu and in Ag. For the Ag series the parameter-composition curves have been determined, those of the Cu series having already been recorded [Abstract 1514 (1939).]. On the whole, fair agreement is observed between the solubilities found respectively by X-ray and by metallurgical methods. Simple relations are found to exist between the distortions produced in the lattice of the solvent by equal small percentages of solute. In any one series group the maximum volume of solute bears a linear relation to the percentage lattice distortion of the solvent lattice at maximum solubility.

3080. Solubility of lead iodate in ammonium acetate solution. S. M. EDMONDS AND N. BIRNBAUM. *Am. Chem. Soc., J.*, **62,** *pp.* 2367–2369, *Sept.*, 1940.—Solubilities have been measured for lead iodate in mixtures of ammonium acetate and ammonium perchlorate of unit ionic strength. The results are in agreement with the conclusion that the reaction involves the formation of the ion $PbC_2H_3O_2^+$. AUTHORS.

3081. Indian vegetable oils. C. GHOSH. *Indian Journ. Phys.*, **14,** *pp.* 153–167, *April*, 1940.—The absorption of air, hydrogen, nitrogen and carbon dioxide, by castor oil at different temperatures within the range 20°C.–90°C. has been measured by the manometric method and the Bunsen absorption coefficients determined. It has been observed that for all the gases there is a certain temperature at which the Bunsen coefficient attains a maximum value, and a mechanism of association between the gas and liquid molecules is suggested to explain the phenomena. The values of viscosity at different temperatures within the same range have been measured in absolute units by the capillary method suggested by Gemant. The values obtained have been found not to satisfy the logarithmic relation of Andrade, and the logarithms of viscosity have been fitted into an equation of the form $\log\eta = \log A - \alpha t + \beta t^2 - \gamma t^3 + \delta t^4$ and the difference between observed and calculated values determined. The variation of refractive index with temperature within the range 0°C.–80°C. has been determined and the variation is found to be a linear one.

SURFACE PROPERTIES.

3082. Relations between thermo-physical properties. A. Ferguson. *Phys. Soc., Proc.*, **52**, *pp*. 759–763, *Nov.*, 1940.—Attention is drawn to a few simple relations which hold with considerable accuracy over the whole range of existence, from freezing point to critical temperature, of certain liquids which are unassociated or whose degree of association is unaffected by changes of temperature. The relations are van der Waals' relation between surface tension and temperature, and Macleod's relation between surface tension and density, which is extended and amplified, leading to an equation which represents, to a high degree of approximation, the variation of orthobaric density with temperature from freezing point to critical point. Results indicate that 2 simple relations demanding an explanation in terms of modern theory are the power law connecting surface tension and temperature, and the relation between surface tension and density, which is independent of temperature. N. M. B.

3083. Surface tension of aqueous solutions of some paraffin chain colloidal electrolytes. H. V. Tartar, V. Sivertz and R. E. Reitmeier. *Am. Chem. Soc., J.*, **62**, *pp*. 2375–2380, *Sept.*, 1940.—A comparison is made of the capillary rise and sessile bubble methods for the determination of the surface tension of solutions of some paraffin chain colloidal electrolytes; the latter method only gave reproducible and accurate results. Data are presented showing the type of time changes and the final equilibrium values of the surface tension of aqueous solutions of some monoethanolammonium soaps, sodium laurate and sodium alkyl sulphonates. Authors.

3084. Surface tension in the system hydrazine-water at 25°. N. B. Baker and E. C. Gilbert. *Am. Chem. Soc., J.*, **62**, *pp*. 2479–2480, *Sept.*, 1940.—The surface tension of aqueous hydrazine solutions at 25° has been measured over the entire concentration range. A maximum surface tension is shown by this system at a concentration of 30–35% of hydrazine. The parachor of hydrazine has been calculated from the surface tension to be 91·5 at 25°. Authors.

3085. Thin evaporated silver films on glass. J. Strong and B. Dibble. *J.O.S.A.*, **30**, *pp*. 431–438, *Sept.*, 1940.—The authors attempt to determine a relationship between the mass of silver evaporated, the distance of a receiving surface from the evaporating source, and the transmission (and reflection) of the resulting film. Such a relationship would facilitate the preparation of transmitting silver films as used in interferometers. Eighteen sets of 6 films each have been prepared and measured, and details are given of evaporation procedure and of the measurements, including surface density determination, scattered light and colour effects, ultra-penumbral deposits, sputtered silver films and models for thin films. It is found that, when the reflectivity of the films is plotted against the transmissivity, a definite curve results. A uniform thin film, approximating the massive metal in structure, appears to offer an adequate model for the α-type films, but for the β-type the following more complex model is proposed: (1) to explain the transmission minima, the film is assumed to have a mosaic structure of relatively large granules exhibiting abnormal physical properties; (2) to explain the observed red scattered light, the larger particles are assumed to be made up of smaller elliptically shaped particles, or they may have small elliptical interstices within them. H. H. Ho.

3086. Calculation of absorber performance and design. Improved methods. G. Horton and W. B. Franklin. *Indust. and Engin. Chem.*, **32,** *pp.* 1384–1388, *Oct.* 1940.—This paper presents the derivation of general absorption and stripping factor equations. No assumptions are involved, and hence the equations are applicable to all cases of absorption and stripping. A simple rule is presented to estimate the knock-out or stripping gradient from plate to plate, and 2 methods of calculating absorber performance are illustrated. These methods of calculating absorber and stripper performance have been compared with plate-to-plate calculations. In spite of discrepancies on intermediate plates, good overall agreement was obtained between both methods and the plate-to-plate calculations. Author.

VISCOSITY AND FRICTION.

3087. Viscosity of carbon dioxide in the critical region. S. N. Naldrett and O. Maass. *Canad. J. of Research, B,* 18, *pp.* 322–332, *Oct.*, 1940.—Measurements of the viscosity of CO_2 in the critical region have been made with great precision by means of an oscillating-disc viscosimeter. The variation of viscosity with temperature at constant density has been determined for 14 different densities. Isothermals have been evaluated from a plot of the isochores. One isothermal was determined directly and is in agreement with those determined indirectly. The form of the viscosity/temperature isochores is not the same as that found by Mason and Maass [Abstract 2043 (1940)] for ethylene, in that there is no minimum at the critical temperature, nor even up to 7°C. above. For the region just above the condensation temperature the viscosity is more dependent on density than on temperature; the isochores are almost flat and are well separated. However, the isothermals are spread between an upper and a lower limit of density, showing that viscosity is not entirely independent of temperature. Time lags were observed in the present investigation in the opposite direction to those observed by Geddes and Maass; this would appear to decrease the strength of their claims that the time lags that they observed are due to the formation of a structure in the liquid state. Authors.

3088. Viscosity of liquids. E. N. da C. Andrade. *Phys. Soc., Proc.*, **52,** *pp.* 748–758, *Nov.*, 1940.—The formula proposed for liquid viscosity at the melting point is $\eta_M = K(A T_M)^{1/2}/V^{2/3}$, where $K = \kappa C N^{-2/3}$ (C = Lindemann's constant, N = Avogadro's number). Available data are examined for various monatomic liquids and a few simple classes of liquids (fused alkali halides), molecules of high symmetry (CH_4, CCl_4, $SiCl_4$), the halogens, and molecules departing greatly from central symmetry (phenyl halides and paraffins) to see how far a fixed value of κ can be attributed to each class. Corrections to the frequency formula are discussed, and discrepancies in the effect of an electric field on the viscosity of polar liquids are explained; in the case of non-polar liquids there appears to be no effect.

Polar liquids are found to fall into 2 classes: those showing no effect (these show no tendency to ionization), and those showing, in general, a large effect; these are all capable of ready ionization through combination with traces of water. N. M. B.

See also Abstracts 3063, 3081.

ASTRONOMY AND ASTROPHYSICS.

COMETS AND METEORS.

3089. Velocity distribution in a field of force. W. C. H. EAKIN AND W. H. MCCREA. *Roy. Irish Acad., Proc. A*, **46,** 8, *pp.* 91–102, *Aug.*, 1940.—These problems deal with the interpretation of statistical data on meteors, and it is an essential feature that collision effects between particles are strictly ignorable. For particles striking a gravitating sphere, the minimum occurs when the r.m.s. velocity of the particles at infinity is 755 km./sec. (approx.). If this velocity were 10 km./sec., the number of particles captured per unit time would be about 37·8 times its minimum value. A. S. D. M.

NEBULAE.

3090. Dynamics of the Andromeda nebula. B. LINDBLAD. *Arkiv f. Mat. Astron. och Fysik, Stockholm*, 27*A*, 2, [8 *pp.*], 1940.—By multiplying intensity along the major axis by distance, the author deduces a rough picture of the integrated mass. By assuming that the edge velocity of 150 km./sec. represents closely the speed in a circular orbit he deduces the formula $M_1 + 3/2\ M_2 e^{-3}$ (arc sin $e - e\sqrt{1 - e^2}) = \Theta^2 R/G$, and if $R = 25'$ and $D = 250\,000$ parsecs, $(M_1 + M_2) = 6 \times 10^9 \times$ solar mass, so that the total nebular mass will be $2 \times 10^{11} \times$ solar mass, in substantial agreement with Hubble's estimate. [See Abstract 2999 (1937).] D. R. H.

3091. Orientation of the extra-galactic nebulae. A. G. WALKER. *Roy. Astron. Soc., M.N.*, **100,** *pp.* 623–630, *June*, 1940.—It is shown that relativity provides an alternative to the possibility that the orientations of nebulae are purely random. There are 3 distinct cases, corresponding in relativistic cosmology to the values 0, 1 and − 1 of k, the curvature of the spatial part of space-time. In each case the inclination of a nebular axis depends at most upon the distance and galactic latitude of the nebula, and the effects estimated from first-order approximations are well within the present range of observations, being of the order of 2 min. of arc per 10^8 light years. The predicted relations can be tested statistically from observations in any region of the sky. These tests can also yield information of importance to relativistic cosmology, such as the values of k and the present " radius " of the universe. AUTHOR.

See also Abstracts 3075, 3099, 3100.

STARS.

3092. Proper motions of some stars in the surroundings of the open cluster Messier 103. A. WALLENQUIST. *Arkiv f. Mat. Astron. och Fysik, Stockholm*, 27*A*, **5,** [7 *pp.*], 1940.—From comparison of new photographs with good Uppsala plates about 40 years old on a Repsold differential machine with × 30 objective the author reports relative photographic proper motions for the 21 stars in the open cluster Messier 103. Nos. 13 and 14 probably form a physical pair with common proper motion of the component stars confirming Kostinsky's observation [see *Astr. Nach.* **191,** 9, 1912]. From Boss values the following corrections to convert relative into absolute proper motions are deduced: $\mu_\alpha \cos\delta = -1\cdot3'' \pm 0\cdot51''$ (p.e.); $\mu_\delta = +0\cdot4'' \pm 0\cdot51''$ (p.e.). D. R. H.

3093. Star-streaming in relation to spectral type from the Cape photographic proper motions. W. M. SMART AND T. R. TANNAHILL. *Roy. Astron. Soc., M.N.*, **100,** *pp.* 688–692, *June*, 1940.—The Cape photographic proper motions of stars of spectral types A5–M have been analysed in 3 spectral groups A5–F5, F8–G5, Ko–M, and also in the aggregate, according to the 2-streams theory [see Abstract 372 (1940)]. The drift-constants, the vertex of star-streaming and the solar motion, have been found for the several spectral groups. The longitude of the vertex is, on the average, about 15° higher than the longitude of the galactic centre. The stars in each spectral group are divided almost equally between the 2 drifts. The ellipsoidal constants have been derived, and they are in good agreement with Jackson's values derived from the same data by a different method. In particular, the ratio of the axes of the velocity ellipsoid for the A5–M stars is found to be 0·64. AUTHORS.

3094. Variable extent of the atmosphere of ζ Aurigae. A. BEER. *Roy. Astron. Soc., M.N.*, **100,** *pp.* 693–699, *June*, 1940.—Spectrophotometric investigations of the behaviour of the K line of ζ Aurigae during its 1937 eclipse reveal, when compared with those of 1934, fundamental changes in the conditions of the star's atmosphere and a much improved agreement with Milne's theory [see Abstract 1045 (1935).] AUTHOR.

3095. Effect of absolute magnitude on star colours. A. HUNTER AND E. G. MARTIN. *Roy. Astron. Soc., M.N.*, **100,** *pp.* 656–668, *June*, 1940.—The observed range of colour amongst stars of any one spectral type is sometimes attributed to differential absorption in space, sometimes to an effect of luminosity, i.e. to an absolute magnitude effect. The 2 causes can be separated if we eliminate the first by confining our attention to stars at the same distance and in the same direction in space, e.g. to stars in galactic clusters. A preliminary examination shows that the dispersion of colour in cluster stars of any one sub-type is of physical origin, since it is larger than can be explained by observational errors. It is possible, then, that colour may correlate with absolute magnitude. Using published colour indices and photographic magnitudes for 879 stars in 24 clusters, correlation coefficients were derived between colour index and absolute magnitude for 20 sub-types between O9 and K0. To extend the investigation to later spectral types (dwarf stars of these types not being observable in clusters) colours and absolute magnitudes of 253 individual K- and M-type stars suffering little space absorption were used; this process, though introducing some uncertainty as to the accuracy of the absolute magnitudes, permits the use of a large range in luminosity. The correlation coefficients found are small at all spectral types, but are probably significant at A (where they are positive) and possibly also at K (where they are negative). These results are confirmed by calculating, sub-type by sub-type, the amount of reddening per magnitude increase of luminosity. The paper suggests reasons why in early-type stars the larger colour indices should be associated with low luminosity, whilst at later types it is the giants which are relatively red. AUTHORS.

3096. Space reddening in the galaxy. A. Hunter and E. G. Martin. *Roy. Astron. Soc., M.N.*, **100,** *pp.* 669–687, *June*, 1940.—A catalogue of gradients of 392 early-type stars is compiled by combining with Greenwich measured gradients the results of 4 series of photo-electric colour index measurements. A linear correlation between gradient excess and distance is used to deduce from each star a selective absorption coefficient β in the galactic plane, assuming an exponential decrease of density of the reddening material away from that plane. Weighting the separate values of β in approximate proportion to the square of the distances of the corresponding stars, mean coefficients are deduced for 12 groups of galactic longitude between 310° and 223°. Spectroscopic distances are used for 308 stars; distances inferred from the intensity of the interstellar K-line for the remaining 84. The 2 series of reddening coefficients so derived agree well with each other, though the 2 scales of distance show discrepancies corresponding to a difference of 4^m in the absolute magnitude scales. These coefficients will not, however, account for the very heavy reddening of 35 stars, and other explanations are sought. Local obscuration seems to play a part in a large proportion of these cases, though the reddening is also correlated with the appearance of "*e*" and "*c*" characteristics in the spectra. Authors.

3097. Spectrum of BD + 30°3639. P. Swings and O. Struve. *Nat. Acad. Sci., Proc.*, **26,** *pp.* 548–553, *Sept.*, 1940.

3098. Physics of white dwarf matter. A. S. Eddington. *Roy. Astron. Soc., M.N.*, **100,** *pp.* 582–594, *June*, 1940.—The theory of the calculation of the pressure of a degenerate gas is reinvestigated, and the author's earlier conclusion [Abstract 1503 (1935)] that $P = Ka^{5/3}$ is the correct relativistic formula is confirmed. It is pointed out that, since the calculation of interaction or perturbation energy is generally impracticable, the success of the method depends on choosing eigen-states for which the perturbation energy is negligible as evidenced by the rarity of transitions. This rules out investigations which employ Dirac wave functions, since they represent states between which transitions are excessively frequent. An analysis is employed which, from molar considerations, is known to satisfy the condition of few transitions. By means of a "consistency test" derived from the consideration of rarefied gas at high temperature, the relation of the pressure to the mechanical vector p_a is uniquely determined. The relation of the white dwarf problem to more typical quantum problems is explained, and apparent contradictions are reconciled. It is shown that the electrons are not strongly concentrated in the neighbourhood of the protons or ions. Author.

3099. Galactic and extragalactic studies. Part VIII. H. Shapley. *Nat. Acad. Sci., Proc.*, **26,** *pp.* 541–548, *Sept.*, 1940.—[See Abstract 2376 (1940).] Throughout the interval from 1·2 to 40 days (which covers the periods of most of the variables known in the Magellanic clouds), a linear relation between the logarithm of the period and the median magnitude is fairly satisfactory. A non-linear curve is adopted which differs but little from the one now in general use. A study of the period/luminosity relation throughout the small cloud reveals no measurable difference depending on the density of star distribution. The scattering of points about the adopted curve is significant, and only a part can be attributed to "cloud thickness". Possibly space absorption within the cloud is spotty in distribution and accounts for some of the larger deviations, but there seems to be a real dispersion in absolute luminosity for Cepheids of the same period. The new value obtained for the distance of the small cloud is affected by the uncertain information on space absorption in the galactic system. AUTHOR.

3100. Galactic and extragalactic studies. Part IX. H. SHAPLEY AND R. B. JONES. *Nat. Acad. Sci., Proc.*, **26,** *pp.* 554–561, *Sept.*, 1940.—The present paper contains in summarized form information on the apparent photographic magnitudes of some 22 000 external galaxies lying in a declination belt centred at + 43°·6.

SUN.

3101. Convective equilibrium and solar limb darkening. A. D. THACKERAY. *Roy. Astron. Soc., M.N.*, **100,** *pp.* 614–622, *June*, 1940.—The consequences of assuming convective equilibrium with $k \propto p$ and $\gamma = 4/3$ in the solar atmosphere are studied. The darkening to the limb in integrated light and in different wavelengths, and the distribution of energy in the continuous spectrum, are very similar to the results predicted by radiative equilibrium and represent the observations almost equally well. Accurate observations are required to distinguish between the 2 types of equilibrium. The wavelength of maximum intensity is further to the violet in convective equilibrium. This may have some bearing on the interpretation of stellar colour temperatures. The same assumption for the equilibrium of sunspots leads to the result that the observed angle- and wavelength-variations of the ratio Spot/Disc may be equally well represented by the assumptions that spot and disc are either both in convective or both in radiative equilibrium. The wavelength variations resulting from a convective spot and radiative disc, or from a radiative spot and convective disc, are at variance with observation. AUTHOR.

3102. Distribution of sunspots over the sun's disc. G. H. A. ARCHENHOLD. *Roy. Astron. Soc., M.N.*, **100,** *pp.* 645–655, *June*, 1940.—Studies of the distribution of sunspots over the sun's disc give evidence that the area of a sunspot already corrected for geometrical foreshortening is affected by a physical foreshortening. The numerical values of this foreshortening are determined for spots of various sizes. The physical foreshortening increases from centre to limb and slightly from small to large spots. At longitude 65° it amounts to about 10 units of area, at longitude 80° to about 50 units. Numerical values of the geometrical foreshortening curve and of the curve of visibility are derived from Greenwich observations. The physical cause of the Maunder effect can be found in the slope of the axes and the preponderance of faculae on the eastern side of sunspots. The E.-W. asymmetry of the size of sunspots accounting for the Maunder effect is a small percentage only of the physical foreshortening. Finally, it follows from the derived curve of visibility that a sunspot group contributes the less to the statistical " character " figure the nearer it is to the limb. AUTHOR.

3103. Variation of faint Fraunhofer lines across the solar disc. M. G. ADAM. *Roy. Astron. Soc., M.N.*, **100,** *pp.* 595–613, *June*, 1940.—In order to test the interlocking hypothesis already proposed [Abstract 1070 (1938)] to account for the limb strengthening of faint lines, equivalent widths at centre and limb of the sun are obtained for 17 abundant-element faint lines and 23 rare-element faint lines in the region λ 4 100. A marked increase in equivalent width at the limb for both classes of faint lines is established. The abundant-element faint lines show a slightly greater increase than the rare-element faint lines. Current theories of line formation are examined, and the strengthening of faint lines is finally attributed to an anomalous temperature distribution in the outer layers of the solar atmosphere. A form for the variation of J_r (black-body radiation) with depth is found which fits the observed limb darkening in the continuous spectrum and predicts limb strengthening for faint lines and weakening for strong lines. The introduction of reduced re-emission into the model also accounts for the increased strengthening of the abundant-element faint lines. AUTHOR.

3104. Spectrum of bright chromospheric eruptions. C. W. ALLEN. *Roy. Astron. Soc., M. N.*, **100,** *pp.* 635–644, *June*, 1940.—High-dispersion spectrograms of bright eruptions on the sun's disc have been obtained; 116 emission lines have been detected and tabulated in various discontinuous regions of the spectrum from 3 922 Å to 6 700 Å. The intensities of the eruption lines when compared with those of the flash spectrum reveal that all Fe^+ lines and all low E.P. Fe lines are strongly enhanced in eruptions. The enhancement of Fe^+ lines is also detected in metallic prominences and "Hot Spots". but this is not the case for the low E.P. Fe lines. Emission lines in some stellar spectra are similar to those in eruptions. No satisfactory explanation of the results has been found. Small variations detected in the intensities of Fraunhofer lines from areas in eruption may be explained if the excitation temperature of the reversing layer is increased by about 100°K. AUTHOR.

See also Abstract 3072.

GEOPHYSICS.

GEODESY.

3105. Correction table for the effect of Coriolis acceleration on bubble sextant altitudes. J. Q. STEWART. *Rev. Sci. Instruments*, **11,** *pp.* 310–311, *Oct.*, 1940.—At modern speeds of aeroplane flight the Coriolis force, to which any moving body is subject on the rotating earth, produces a sensible displacement of the horizon as found by gravity. This note presents the necessary correction formulae and tables for astronomical altitudes taken in flight with the bubble sextant. This correction usually exceeds the atmospheric refraction, and in precise celestial "avigation" its application should become standard routine. AUTHOR.

GEOPHYSICS, APPLIED.

3106. Gravitational and magnetometric methods of geophysical prospecting. A. H. MILLER. *Dominion Observat., Ottawa, Publ.*, **11,** 6, *pp.* 177–258, 1940.—This report is a summary of investigations made with the torsion balance and the magnetometer by the Dominion Observatory. Surveys covered 3 faults, deposits of asbestos, chromite, pyrite, lignite, siderite and salt, as well as a buried granite ridge associated with the occurrence of natural gas and oil at Moncton, New Brunswick. Certain of the buried structures were successfully located and outlined with the instruments. It is concluded that there are probably numerous other instances in Canada where the instruments might be successfully and profitably employed. AUTHOR.

HYDROSPHERE, PHYSICS OF THE.

3107. Hydrological studies on the Yangtze river. S. HAYAMI. *J. Shanghai Sci. Inst.*, **1**, *pp.* 263–291, *June*, 1940.—The daily records of river level for the period 1865–1890 are analysed. Monthly means are calculated and successive smoothing applied. Harmonic analysis is also applied to the smoothed curves. For the period 1865–1936 8 physically real periods were found, all except 2 of which were overtones of the Brückner period. The Brückner variation is rapid in the rising stage from dry to wet period and slow in the reverse stage. The stage in spring has a remarkable negative correlation to the intensity of the summer monsoon over China. The water level is high in the period of intense sunspot activity. R. S. R.

LAND, PHYSICS OF THE.

3108. Explosive activities of volcano Kusatu-Sirane during 1937 and 1938. Part I. T. MINAKAMI. *Tokyo Univ. Earthquake Research Inst., Bull.*, **17**, *pp.* 590–622, *Sept.*, 1939.—After preliminary activity a violent explosion occurred in the volcano on Oct. 5, 1938, when large quantities of gas and ash were ejected from craters. Micro-earthquakes occurred and continued for many months after. Inside one crater explosions were located on a S.E.–N.W. fissure, different from any earlier active fissures in the crater. The region of high temperature is restricted to a narrow zone along the active fissure. The quantity of water that filters through the fissure at the bottom of the lake is estimated at from 500 to 1 000 tons per day. The gas ejected was mostly aqueous vapour, but on some occasions large quantities of evaporated sulphur were emitted with the steam. The floor of the crater was shown by borings to consist of alternating layers of precipitated sulphur, agglomerate and ash. The temperature variations were due partly to variations of subterranean heat and partly to the amount of water seeping down. The gas pressure at the moment of explosion was estimated at about 150 atm. The seat of the disturbance producing the recent explosions is considered to lie near the earth's surface. W. A. R.

3109. Composition and properties of shore and dune sands. W. H. BARRETT. *Geolog. Mag.*, **77**, *pp.* 383–394, *Sept.–Oct.*, 1940.—Samples were obtained from Perranporth, Cornwall. For each sample the mechanical and chemical compositions and the heavy mineral content were found and some measurements of rounding made. Results show that (1) the 50% grade of all samples from this locality varies only between narrow limits; (2) the high degree of grading of the samples is due to water rather than to wind action; (3) heavy mineral grains are more readily left behind during wind transport than quartz and shell fragments; (4) incipient rounding of sand grains begins with wind transport and bears some relation to the distance transported, but water has only a slight effect for grains up to 0·5 mm. diameter; (5) shell fragments appear to accumulate more in medium than in coarser or finer grades, possibly due to their greater fragility and to the greater solubility in water of the finer particles. R. S. R.

***3110. Subsurface pressure and temperature gauges and samplers.** J. F. Purdum. *Mines Mag.*, **30,** *pp.* 435–438, *Aug.*, 1940.—New non-electrical instruments are described by means of which samples of liquids, such as oil in deep wells, may be brought to the surface unchanged and the original pressure and temperature measured. They are the product of the Humble Oil and Refining Co., of U.S.A. Pressure is measured by a spring balance with various additions for several ranges, pressures measured at predetermined time-intervals, etc. Maximum-reading thermometers are incorporated in some of these gauges. Some of the gauges measure and record the pressure whilst the instrument is in the bore, the reading being made on withdrawal to the surface. E. H. W. B.

METEOROLOGY.

3111. Origin of the D-layer. S. Deb. *Indian Journ. Phys.*, **14,** *pp.* 89–92, *April,* 1940.—The origin of the D-layer of the upper atmosphere is considered to be due to the settling of dust-like metallic particles of meteoric origin on the inversion level at 55–60 km. The inversion of temperature with its consequent over-stability is considered to be due to the heating of the atmosphere by high-speed meteors that come to earth continuously from space. With this idea a number of optical and electrical phenomena found associated with this layer are accounted for. Lastly, it is found that the potentiality of this layer for radio fade-outs discovered by Dellinger can be explained.

3112. Early morning variation of ionization and the true height of region F of the ionosphere. S. P. Ghosh. *Indian Journ. Phys.*, **14,** *pp.* 101–107, *Aug.*, 1940.—Results of observations carried out at Calcutta (22° 33′ N) for a period of 1 year (1937-38) on the early morning variation of F-ionization are described. It is found that the average F-ionization, which decreases during the earlier part of the night, begins to increase after attaining a minimum. The hour at which the increase begins varies with the season. It occurs earliest in mid-winter and shifts towards the early morning hour with the approach of summer. In mid-summer there is no pre-sunrise increase of ionization. This is explained as due to cooling of the layer as a whole. Further, it is found that the early morning minimum occurs after sunrise at region F in all seasons. In order to find out the hour of sunrise at region F, its true height has been calculated from the observed $(P' - f)$ curves. Generally, the true height has been found to be about 80 km. less than the observed equivalent height. Curves depicting the variation of the hour of sunrise with height, taking into account the effect of atmospheric refraction, have been drawn. Author.

3113. Instrumental error in measurement of air velocity by 2 theodoliths. A. Grigoriu. *Bull. Soc. Roumaine de Physique*, **41,** 75, *pp.* 17–32, 1940.—The author develops a method of computing the errors in the determination of the position of a balloon which floats in the atmosphere. The error of the observation is read on a net of curves of equal error which are constructed in the horizontal plane and the vertical plane passing through the position of the balloon. Around each point of a plane there is an uncertainty domain, limited by a circle whose radius equals the absolute error in that point. For velocity measurements the distances between the circles whose centres lie at the ends of the displacement vector must not be less than half the length of this vector itself. This leads to conditions for the vertical velocity of the balloon, for the time interval between successive measurements and for the possibilities of determination of vertical velocity of air. AUTHOR.

3114. Influence of lunar periodicity on climate according to O. Pettersson. C. BENEDICKS. *Arkiv f. Mat. Astron. och Fysik, Stockholm*, 27*A*, **7**, [15 *pp*.], 1940.—Detailed graphical examination of Berlin and Stockholm winter temperature records over 160 years shows the following periods: (1) The 11·1-year period is considerably more regular than actual sunspot occurrence; (2) Pettersson's 9-year node-apsidal period of the moon; (3) Wojeikoff's warm-winter and Pettersson's cold-winter period of 8 years; (4) another 10-year series of mainly warm years. A combination of (1) and (2) leads to a 45-year long period which is particularly well marked in the mean curve based on 21 years' data; the general increase in temperature of the Swedish polar neighbourhood since 1800 is also marked. D. R. H.

See also Abstracts 3121, 3122, 3181.

SEISMOLOGY.

3115. Formation of boundary waves at the surface of a discontinuity within the earth's crust. Part II. K. SEZAWA AND K. KANAI. *Tokyo Univ. Earthquake Research Inst., Bull.*, **17**, *pp*. 539–546, *Sept*., 1939.—Continuing the work of a previous paper [Abstract 4876 (1938)] the method is extended from 2 to 3 dimensions. W. A. R.

TERRESTRIAL ELECTRICITY AND MAGNETISM.

3116. Equilibrium of ionization in the lower atmosphere. J. J. NOLAN. *Roy. Irish Acad., Proc. A*, **46**, 7, *pp*. 77–90, *Aug*., 1940.—Recent experimental results from widely separated observatories lead to the suggestion that the equilibrium of small ions in the lower atmosphere may be represented by the equation $q = an + bnZ$ where q is the number of ion-pairs produced per cm^3. per sec. and n and Z are concentrations of ions and nuclei (both charged and uncharged). The hypothesis is tested by plotting $1/n$ against Z for the results obtained from any one place. The graphs are reasonably linear; but, whereas the constant a is the same for all places, b is different for different observatories. It is suggested that this variation indicates a different average size of the nuclei in different parts of the world. The average life of a small ion in nucleus-free air is 67 sec., while in an atmosphere like that at Kew its life is only 5 sec. J. P. A.

3117. General meteorological aspects of thunderstorm electricity. H. R. BYERS. *Terr. Mag.*, **45**, *pp*. 345–350, *Sept*., 1940.

3118. Magnetic Results, 1927-1937. C. A. FRENCH AND R. G. MADILL. *Dominion Observat., Ottawa, Publ.*, **11**, 7, *pp*. 263–326, 1940.

3119. Theory of the first phase of a geomagnetic storm. S. CHAPMAN AND V. C. A. FERRARO. *Terr. Mag.*, **45**, *pp*. 245–268, *Sept*., 1940.—An exact solution is given (apart from the neglect of displacement currents) for the motion and electromagnetic fields of a uniform, neutral, ionized distribution of ions and electrons, initially situated on an infinitely long circular cylindrical surface and projected radially inwards towards the axis of the cylinder, in the presence of a permanent magnetic field which is everywhere parallel to the axis and varies in intensity as the inverse cube of the distance from the axis. It is shown that the ions and electrons will remain "united", i.e. will continue to lie on 1 cylindrical surface, if the total ionic (or electronic) charge exceeds a certain lower limit; an electric

current will be induced, flowing round the cylindrical surface and increasing the magnetic intensity within the cylinder. The problem is discussed as one which partly illustrates the first phase of a magnetic storm and, in particular, the sudden increase of H during only a few minutes; it clearly shows that, when a neutral ionizing stream advances into regions of increasing intensity in a magnetic field, the electrostatic attraction between the ions and electrons can carry the electrons forward far beyond the distances they could attain alone, if the stream is sufficiently dense.
AUTHORS.

3120. Geomagnetic tides in horizontal intensity at Huancayo. J. BARTELS AND H. F. JOHNSTON. *Terr. Mag.*, **45,** *pp.* 269–308, *Sept.*, 1940.—After an introductory survey of the main features of the solar and lunar daily variations, S and L, in horizontal intensity, H, in January at Huancayo, days with conspicuous lunar influences, geomagnetic tides, are discussed. A separation of S and L on such " big-L-days " is attempted. Daily ranges A in H are then introduced for the study of the intensity of S and thereby of the solar wave-radiation W. Up to international character figures $C = 1 \cdot 1$ A is found independent of changes in the solar corpuscular radiation P. Various methods for studying L are compared. Lunar semi-monthly waves in the ranges A are computed and discussed in their change with season and sunspot cycle. In the months November to March, when L is larger than in the rest of the year, L and S increase in their effects on A proportionally to each other from sunspot minimum to sunspot maximum, but around June, when L is small, it does not participate in the change of S with the sunspot cycle. The day-to-day variability of S and L is studied in some detail; S and L fluctuate rather independently of each other, and the relative fluctuations of L seem to be greater than those of S. The elimination of the lunar effect A_L is described; $(A - A_L) = A_S$ is proposed as a measure for W. AUTHORS.

3121. Geomagnetic 3 hr.-range indices for 1938 and 1939. J. BARTELS, N. H. HECK AND H. F. JOHNSTON. *Terr. Mag.*, **46,** *pp.* 309–337, *Sept.*, 1940.—The paper gives 3 hr.-range indices K for 7 observatories for July 1, 1938, to December 31, 1939, world-wide 3 hr.-range indices K_w for 1938 and 1939 and, based on K_w, daily indices B, and monthly frequencies and averages. It is shown how the indices K are standardized by means of keys for transforming K into reduced indices K_r. The world-wide K_w is introduced as an average of the reduced indices K_r, in which the K_r from polar stations enter with higher weight than the K_r from equatorial stations. K_w is proposed as a measure of the intensity P of solar corpuscular radiation. AUTHORS.

3122. Solar radiation and geomagnetism. J. BARTELS. *Terr. Mag.*, **45,** *pp.* 339–343, *Sept.*, 1940.—Solar wave-radiation, W, and corpuscular radiation, P, may be estimated in their variations of intensity by their geomagnetic effects. A classification of magnetic storms is proposed, and geomagnetic evidence for the travel times of solar corpuscles is discussed.
AUTHOR.

3123. Magnetic storm of March 24, 1940. A. G. MCNISH. *Terr. Mag.*, **45,** *pp.* 359–364, *Sept.*, 1940.

***3124. Device for increasing the sensitivity of magnetic variometers.** J. H. SHAXBY. *Journ. Sci. Instruments*, **17,** *pp.* 257–259, *Nov.*, 1940.—A magnet auxiliary device is described, by means of which the gravitational controlling couple of a magnetic variometer is opposed by a weaker deflecting couple. The net restoring moment is thus diminished, and sensitivity to variations in the earth's magnetic field correspondingly increased. This increase may be 5- or 6-fold in the field, greater at a base station. No opening of the instrument is involved, the device being simply clipped to the outer case when required. Its removal leaves the variometer with its former sensitivity. It is shown that change of temperature causes no appreciable error. AUTHOR.

See also Abstract 3195.

RADIOACTIVITY.

3125. Decay constant of H^3. R. D. O'NEAL AND M. GOLDHABER. *Phys. Rev.*, **58,** *pp.* 574–575, *Sept.* 15, 1940.

3126. General rule concerning the half-value periods of electron-emitting nuclei. A. E. HAAS. *Nat. Acad. Sci., Proc.*, **26,** *pp.* 565–567, *Sept.*, 1940.—Unstable electron-emitting nuclei may be arranged in series according to their isotopic number, i.e. the number of neutrons less the number of protons; or the mass number less twice the charge number. In sequences of such nuclei with the same isotopic number the half-life period increases from one place to the next. Only 4 nuclei out of 60 fail to agree with this generalization. It is found that those electron-emitting nuclei for which both charge and mass number are odd would be transformed into stable nuclei by the addition of a proton. Some regularity is also found in the case of the series for which the isotopic number is — 1, consisting of positron emitters. [See Abstract 1968 (1940).] A. J. M.

3127. Analysis of experimental data for β-disintegration. J. ITOH. *Phys. Math. Soc., Japan, Proc.*, **22,** *pp.* 531–550, *July*, 1940.—The nuclear mass differences of neighbouring isobars, the Sargent diagram, and possible selection rules for β-transition are discussed. The Sargent relationship is also considered for all radioactive elements, light and heavy. It can be interpreted satisfactorily on the basis of the Fermi theory of β-decay. A. J. M.

3128. Fission products and induced β-ray radioactivity of uranium by fast neutrons. T. YASAKI. *Inst. Phys. and Chem. Research, Tokyo, Sci. Papers, No.* 980, *pp.* 457–472, *July*, 1940.—U, activated by fast neutrons from the bombardment of Li by deuterons, gives rise to Pd, Ag, Cd and In, and other fission products already reported. Pd, Ag, Cd and In, have been separated from the products by chemical methods, and their activities have been examined. The following radioactive nuclei were identified (half-life periods given in parentheses): Pd^{112} (17 hrs.), Pd$^{?}$ (26 min.), Ag^{111} (7·5 days), Ag^{112} (3·5 hrs.), Cd^{115} (56 hrs.), Cd^{117} (3 hrs.), Cd$^{?}$ (50 min.), In^{115} (4.·5 hrs.), In^{117} (2 hrs.). Neutrons from a Be-deuteron source, slowed down by paraffin, did not produce the above isotopes. When irradiated with fast neutrons, U shows a strong β-radioactivity, even after removal of all fission and disintegration products. This radiation has a half-life of 6·5 days and probably decays to an element of atomic number 93. A. J. M.

3129. Radioactivity produced by proton bombardment of bromine and iodine. E. C. CREUTZ, L. A. DELSASSO, R. B. SUTTON, M. G. WHITE AND W. H. BARKAS. *Phys. Rev.*, **58,** *pp.* 481–486, *Sept.* 15, 1940.—Br bombarded with 5–6 eMV protons emits electrons with half-lives 13 ± 2 sec.

and 55 ± 2 sec. A β-spectrograph shows these to be conversion electrons from at least 2 γ-rays of energies 127 and 187 ekV. Physical and chemical tests indicate that the activity is from a Kr isotope. The long-period $Kr^{79,81}$ is found to have a half-life of 34·5 ± 1 hrs. and a positron upper limit of about 0·4 eMV. Iodine targets similarly emit electrons with a half-life of 75 ± 1 sec., shown to be conversion electrons from at least 2 γ-rays of energies 125 and 175 ekV, coming from a Xe isotope. Radiation consisting of electrons, X-rays and probably γ-rays, decaying with a half-life of 34 ± 2 days, is also found. Secondary electrons produced in the target material or in Pb absorbers by X-rays from the source account for about ⅔ of the total activity measured by the electroscope. AUTHORS.

3130. Theoretical maxima and minima in the anomalous scattering of α-particles. P. SELIGMANN. *Phys. Rev.*, **58**, *pp.* 492–498, *Sept.* 15, 1940.—The work of Wenzel on the determination of theoretical maxima for the anomalous scattering of α-particles by light nuclei under the assumptions of the 2-body problem has been generalized to the case of a finite number of l values and extended to include minima. The results have a more general validity if the scattering nucleus has zero spin. Possible applications to analyses of experimental data are discussed. Treatment of the existing data for α-particles scattered by carbon and oxygen indicates that l values at least as large as 2 are effective in producing the anomalies in both cases. This conclusion is verified for carbon by a phase-shift analysis. AUTHOR.

3131. Retardation of α-rays in Mg, Zn and Mo. G. MANU. *Bull. Soc. Roumaine de Physique*, **41**, 75, *pp.* 33–41, 1940.—The retardation of the α-particles of ThC′ and ThC when passing through thin foils of Mg, Zn and Mo is studied. The results are in good agreement with the theoretical data deduced from Bethe and Bloch's formula if the average excitation energy is taken as 160 V for Mg, 345 V for Zn and 450 V for Mo. AUTHOR.

3132. Internal conversion of γ-radiation in the L shell. M. H. HEBB AND E. NELSON. *Phys. Rev.*, **58**, *pp.* 486–491, *Sept.* 15, 1940.—The non-relativistic calculations of the internal conversion of electric multipole radiation which have been made for the K shell are extended to the L shell. Numerical values of the conversion coefficient for both the K and L shells are given and curves showing the ratio of the K conversion to the L conversion for different energies and atomic number are presented. This latter ratio is quite sensitive to the multipole order and varies between 0·1 and 10 in the range in which the calculations are valid. A simple relativistic formula for the conversion of magnetic multipole radiation is given. AUTHORS.

RADIATION.

ELECTRO-OPTICAL AND MAGNETO-OPTICAL EFFECTS.

See also Abstract 4346.

EMISSION.

3133. Theory of the Compton effect. K. C. KAR. *Indian Journ. Phys.*, **14**, *pp.* 117–122, *April*, 1940.—The wave-statistical theory of interaction between radiation and matter previously developed [Abstract 1116

(1940)] is extended by taking into account the energy and momentum of recoil of the scattering electron. The well-known Einstein-Dirac formula for the intensity of Compton scattering is derived. AUTHOR.

3134. Air mass effect on cosmic-ray intensity. D. H. LOUGHRIDGE AND P. F. GAST. *Phys. Rev.*, **58**, *pp.* 583–585, *Oct.* 1, 1940.—The existence of an effect upon cosmic-ray intensity at the boundaries separating different types of air masses is clearly established and has lately received additional confirmation. This effect is postulated by Blackett to explain the seasonal variation in cosmic-ray intensity, although in this case both temperatures and pressures in the upper air contribute to the change. Work is now in progress to compare cosmic-ray intensities with the daily meteorological balloon records which have recently become available. AUTHORS.

3135. Energy distribution of incoming cosmic-ray particles. R. A. MILLIKAN AND H. V. NEHER. *Am. Phil. Soc., Proc.*, **83**, 2, *pp.* 409–428, 1940.—By sending recording cosmic-ray electroscopes essentially to the top of the atmosphere in a series of 6 different latitudes the total amount of cosmic-ray energy that reaches the earth in each of these latitudes is found. By taking the successive differences between these measured energies the distribution of energies among the electrons which continuously shoot through space is obtained. These energies are found to have a definitely banded structure such that at least 60% of all cosmic-ray energy is carried by electrons of energy between 2 billion eV and 17 billion eV. This band has a strong maximum in the region between 6 billion and 10 billion eV. There are also indications of a band at 2 billion eV. There should be bands in just these locations if the 4 most abundant elements except hydrogen that Bowen and Wise find in interstellar space have the capability, when they become free from frequent atomic collisions, of occasionally transforming their total rest-mass energy into cosmic rays. Such a transformation in the case of the C, N and O atoms would yield energies of 6, 7 and 8 respectively. In the case of He the corresponding energy would be 2 billion eV. These results need repetition and checking with increased accuracy. AUTHORS.

3136. New type of variations in cosmic radiation. H. ALFVÉN. *Arkiv f. Mat. Astron. och Fysik, Stockholm*, 27 *B*, **1**, [6 *pp.*], 1940.—Using a coincidence method with a triple counter arrangement, a 10% fluctuation was recorded, according to whether the radiation was incident from the N. or from the S. The decrease in intensity in one direction is approximately equal to the increase in intensity from the other. Asymmetry in atmospheric pressure would only partly account for the phenomena and the effect remains generally unexplained. F. C. C.

FLUORESCENCE AND PHOSPHORESCENCE. LUMINESCENCE AND AFTERGLOW.

3137. Quenching of fluorescence in solution. R. W. STOUGHTON AND G. K. ROLLEFSON. *Am. Chem. Soc., J.*, **62**, *pp.* 2264–2268, *Sept.*, 1940.—The effects of changes of temperature, viscosity and dielectric constant, of the solvent on the quenching of the fluorescence in solution have been studied. The results show that the quenching constant decreases as the viscosity increases, changes with ionic strength in solvents of different dielectric constant as predicted by the equation derived by means of the Debye-Hückel theory and Brönsted's equation for bimolecular reactions; at zero ionic strength changes as predicted by Scatchard's equation for bimolecular reactions, and increases with temperature, but this increase is primarily due to a decrease in the viscosity of the solvent. AUTHORS.

3138. Life time of fluorescence in diacetyl and acetone. G. M. ALMY AND S. ANDERSON. *J. Chem. Phys.*, **8**, *pp.* 805–814, *Oct.*, 1940.—The mean life time of the fluorescence of diacetyl vapour has been determined by direct measurement with a phosphoroscope to be $1{\cdot}65 \times 10^{-3}$ sec. Quantitative measurement of the diffusion of the excited molecules from a beam of exciting illumination, at different pressures, has also been made, and the results are compatible with this life time. Integration of the absorption coefficient over the band associated with the fluorescence leads to a life time of the excited state of 10^{-5} sec. To explain this discrepancy various mechanisms are considered; following light absorption, $X \rightarrow A$, the diacetyl molecule goes without radiation into a long-lived state M, lying near A. Fluorescence occurs only upon return to A. M may correspond to a tautomeric rearrangement of the molecule. Acetone, radiated with λ3 130, shows fluorescence identical with that of diacetyl radiated with λ4 358, but the fluorescence grows with time. It can be produced immediately with high intensity by adding diacetyl. The growth curve has been determined and is of form, $I_t = I_0 (1 - e^{kt})$. Diffusion experiments show the life time of the fluorescence in acetone to be equal to that in diacetyl, and the life time, or rate of decay, is independent of exciting intensity. The conclusion is that the same molecule, presumably diacetyl, is responsible for the fluorescence in both cases. Possible mechanisms for the excitation of diacetyl in acetone are discussed. AUTHORS.

3139. Theory of cathode luminescence. U. FANO. *Phys. Rev.*, **58**, *pp.* 544–553, *Sept.* 15, 1940.—A tentative explanation is given of experiments concerning the dependence of the brightness of a luminescent material on the voltage of electron bombardment [Abstract 2552 (1937)]. A model is assumed in which surface effects prevail over luminescence in using radiation energy. The possibility of a quantitative theoretical treatment is largely due to symmetry properties in the diffusion of scattered electrons in a solid body. AUTHOR.

INTERFERENCE, DIFFRACTION AND SCATTERING.

***3140. Optical properties of the grating interferometer.** J. H. SCHROEDER AND B. P. RAMSAY. *J.O.S.A.*, **30**, *pp.* 355–361, *Aug.*, 1940.—A mathematical treatment of the adjustments, order of interference and resolving power, magnifying power and dispersion, of the instrument. N. M. B.

See also Abstract 3085.

PHOTOCHEMISTRY (INCLUDING PHOTOGRAPHY).

3141. Mercury photosensitized decomposition of ethane. E. W. R. STEACIE AND R. L. CUNNINGHAM. *J. Chem. Phys.*, **8**, *pp.* 800–804, *Oct.*, 1940.—The mercury photosensitized decomposition of ethane has been investigated at temperatures up to 475°C. It is found that the products of the reaction are very similar to those at low temperatures. It is concluded that the primary step is a C — H bond split, and that the most important secondary reactions are $H + C_2H_6 \rightarrow C_2H_5 + H_2$, $H + C_2H_5 \rightarrow 2CH_3$. The quantum yield approximately doubles on going from 100° to 475°C. No evidence of chain characteristics is found up to 475°C., and it is concluded that the mechanism of the reaction at high temperatures does not differ essentially from that at low temperatures. AUTHORS.

3142. Rebromination theory of photographic solarization. J. H. Webb and C. H. Evans. *Kodak Research Lab., Comm. No.* 775. *J.O.S.A.*, **30,** *pp.* 445–454, *Sept.*, 1940.—The rebromination theory of photographic solarization attributes this phenomenon to the latent-image silver being attacked by photolytically formed bromine during great over-exposure. With the purpose of testing the validity of this theory a series of experiments was carried out on a photographic emulsion showing strong solarization. These experiments consisted of exposures at different temperatures over the range + 68°C. to − 196°C., exposures on emulsions treated with various bromine acceptors, tests on emulsions which had been exposed and then treated with silver halide solvents, comparison tests of solarization with physical and chemical development, and experiments with different intensities of exposing radiation. All the experimental results fit in with the rebromination theory of solarization. Authors.

PHOTOMETRY.

3143. Use of step weakeners in photographic photometry. G. E. Moore and H. W. Webb. *J.O.S.A.*, **30,** *pp.* 413–414, *Sept.*, 1940.—This paper describes the calibration and use of a 5-step weakener in determining the intensities of spectral lines. The employment of a very constant source of radiation consisting of a quartz mercury arc, the voltage of which was held to ± 0·2 V by an air jet controlled by a relay in the arm of a Wheatstone bridge, made the calibration and use of the weakener comparatively simple and rapid. The results of actual measurements are given to illustrate the precision to be expected when using such a weakener. Authors.

*__3144. New transmission photometer.__ J. T. M. Malpica and W. R. Fanter. *Gen. El. Rev.*, **43,** *pp.* 384–385, *Sept.*, 1940.—Describes a robust and compact form of photo-electric microphotometer for measuring the density of spectral lines on a spectrographic plate. J. W. T. W.

POLARIZATION.

3145. Solvent action on optical rotatory power. Parts III and IV. C. O. Beckmann and H. C. Marks. *J. Chem. Phys.*, **8,** *pp.* 827–839, *Oct.*, 1940.—[See Abstract 1626 (1938).] By taking into account the London "dispersion" forces and the structural characteristics of a liquid system, an equation for the change of rotivity per mole of dipole solvent in unit volume for liquid solutions is obtained, which has the same form as the equation obtained by Beckmann and Cohen for a mixture of gases that are perfect except for dipole inter-action. Experimental data are presented to demonstrate the validity of the equations for the change of rotivity with solvent. Mixtures of polar and non-polar solvents of both aromatic and aliphatic types were used with dipropionyl-diethyl-*d*-tartrate and *l*-menthyl acetate as optically active substances. The data are discussed in terms of the theory and essential agreement is found in all cases over a wide range of concentrations. Authors.

REFLECTION, REFRACTION AND DISPERSION.

*__3146. Method for obtaining long optical paths.__ H. D. Smith and J. K. Marshall. *J.O.S.A.*, **30,** *pp.* 338–342, *Aug.*, 1940.—A simple arrangement of plane and spherical mirrors is described whereby an absorption spectrum, for a path length of several hundred feet, of a liquid or gas, available in a column of limited length only, could be obtained with a relatively short exposure time. N. M. B.

***3147. Refractive index of matter in cylindrical form.** A. H. PFUND. *J.O.S.A.*, **30,** *pp.* 410–412, *Sept.*, 1940.—A description is given of a simple set-up which may be used for demonstrations or laboratory work. Refractive indices of transparent solids (in the form of cylindrical rods) or of liquids (contained in test tubes) are determinable with a fair degree of accuracy. A. H.

***3148. The prism and the theory of optical resolution.** B. P. RAMSAY, O. T. KOPPIUS AND E. L. CLEVELAND. *J.O.S.A.*, **30,** *pp.* 439–444, *Sept.*, **1940.**

See also Abstracts 3081, 3085.

SPECTROSCOPY.

3149. Properties of the witch of Agnesi—Application to fitting the shapes of spectral lines. R. C. SPENCER. *J.O.S.A.*, **30,** *pp.* 415–419, *Sept.*, 1940.—The witch of Agnesi, $y = ha^2/(a^2 + x^2)$, is of importance to physicists because it approximates the spectral energy distribution of spectral lines, particularly X-ray lines. This paper reviews the known properties of the witch such as graphical construction, parametric form of the equation and *n*th derivatives. New series for these derivatives are developed. The points on the curve whose ordinates are ¼, ½ and ¾, of the maximum have special properties which are described. AUTHOR.

3150. Nuclear isotope shift in the spectrum of ZnH. S. MROZOWSKI. *Phys. Rev.*, **58,** *pp.* 597–599, *Oct.* 1, 1940.—The structure of the lines in the (0, 0) band of the band system $^2\Pi_{\frac{1}{2}} \rightarrow {}^2\Sigma$ of ZnH has been studied by means of a Fabry-Perot etalon. The spectrum was excited in a hollow cathode tube. A structure caused by the isotopic constitution of Zn was observed for the lines near the head of the branch $^0P_{12}$. The measured shifts are larger than those calculated by the usual formulae for the vibrational and rotational isotope effects, thus showing the presence of an additional shift, at least partly of nuclear origin, amounting to about $0{\cdot}007$ cm^{-1}. for the consecutive isotopes of Zn of even mass. This case is quite similar to that of the nuclear shifts in HgH, the chief differences being that they are about 10 times smaller in absolute value, and in the opposite direction. AUTHOR.

3151. Energy levels of chrome alum. R. FINKELSTEIN AND J. H. VAN VLECK. *J. Chem. Phys.*, **8,** *pp.* 790–797, *Oct.*, 1940.—The energy levels for the configuration d^3 of the Cr ion in Cr alum are calculated by starting with the empirical spectroscopic data on the free Cr^{+++} ion and then making the assumption that the interatomic forces in the solid state can be represented by a crystalline potential of cubic symmetry whose magnitude is taken from Schlapp and Penney's theory of the magnetic susceptibility. The particular point to be tested is whether in the solid there is a doublet level only 15 000 cm^{-1}. above the basic quartet state, as predicted from the study of Spedding and Nutting's data on the Zeeman effect [Abstract **3162** (1940)]. The computed deepest doublet is about 18 200 cm^{-1}. higher than the ground level, but the discrepancy is not excessive in view of uncertainties in the parameters of the crystalline field and the fact that any " 1-atom " model is only an approximation in the solid state. It is very essential in computing the positions of excited levels to include elements of the crystalline potential which are non-diagonal in the quantum number *L*, for without them the lowest doublet is much too high, viz. 30 000 cm^{-1}. above the ground term. On the other hand, the effect of these non-diagonal members is shown to be unimportant for the ground level of greatest multiplicity, not merely for Cr^{+++} but also for other salts of the iron group, so that previous calculations by various writers on magnetic susceptibilities are not appreciably impaired by their assumption of Russell-Saunders coupling. AUTHORS.

3152. Infra-red absorption of phenol and its halogen derivatives in the region of the 2nd overtone of the OH absorption. O. R. WULF AND E. J. JONES. *J. Chem. Phys.*, **8**, *pp.* 745–752, *Oct.*, 1940.—Orthohalogen and symmetrically trihalogen substituted phenols in the region of the 2nd overtone of the OH absorption show behaviour that is similar to that in the region of the 1st overtone but with increased displacement of the component absorptions. Subsidiary peaks are observed in the region of the 2nd overtone and appear to stand in ordered relation to the principal peaks. In the present work the ortho- and symmetrically trichloro-, bromo-, and iodo-phenols as well as pentachlorophenol and phenol itself have been studied in carbon tetrachloride solution. The tendency of phenol to associate in a series of polymers has been studied by means of the phenol absorption. Relative to phenol the association of the substituted phenols is small. AUTHORS.

3153. Combination frequencies associated with the 1st and 2nd overtone and fundamental OH absorption in phenol and its halogen derivatives. O. R. WULF, E. J. JONES AND L. S. DEMING. *J. Chem. Phys.*, **8**, *pp.* 753–765, *Oct.*, 1940.—Absorption maxima occurring in the near infra-red spectra of phenol and 7 of its halogen derivatives have been measured and interpreted as combination frequencies in which the valence vibration of the OH group combines with frequencies of the body of the molecule. Certain of these absorptions underlie some of the trans-peaks of the orthohalogen phenols causing such a trans-peak to appear of larger area than that due to the trans-peak alone. A group of the combination frequencies which lie in the range 1 000–1 600 cm^{-1}. above the 1st overtone OH absorption have been observed to be an order of magnitude weaker in the frequency range twice the values above the first overtone OH and also above the fundamental OH absorption, apparently involving 2 units of vibration in the combining frequencies. A close correspondence is found between the frequencies involved in these combination tones and the frequencies which have been observed in some of these compounds in the deep infra-red and in Raman spectra. AUTHORS.

3154. Infra-red spectrum of potassium cyanate solutions. D. WILLIAMS. *Am. Chem. Soc., J.*, **62**, *pp.* 2442–2444, *Sept.*, 1940.—Measurements of the infra-red transmission of KOCN solutions have been made in the region 2 to 14μ. For freshly prepared solutions intense bands were observed at 4·6 and 11·5μ and a less intense band near 7·4μ. In the spectra of solutions which had been allowed to stand for several days the absorption in the 7μ regions was found to be more intense, while additional absorption bands made their appearance near 3·5 and 5·9μ. It is suggested that the 4·6 and 11·5μ bands arise from vibrations of the cyanate ion, while the additional absorption is produced by ammonium and carbonate groups formed by hydrolysis. AUTHOR.

3155. Ultra-violet absorption of NO$_2$. L. HARRIS, G. W. KING, W. S. BENEDICT AND R. W. B. PEARSE. *J. Chem. Phys.*, **8**, *pp.* 765–774, *Oct.*, 1940.—A system of 8 discrete and several diffuse bands in the ultra-violet

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absorption spectrum of NO_2 has been analysed. From the positions of the bands and their temperature coefficient of absorption the upper state intervals have been determined as 523 and 714 cm^{-1}., those of the lower state as 749 and 1 319 cm^{-1}. The latter are not the same as the fundamentals deduced from infra-red data. Different possibilities of reconciling these intervals are discussed. AUTHORS.

3156. Rotational structure of the ultra-violet bands of NO_2. L. HARRIS AND G. W. KING. *J. Chem. Phys.*, **8**, *pp.* 775–784, *Oct.*, 1940.—The rotational structure of the 2 491 Å band in the ultra-violet absorption spectrum of NO_2 is not completely resolved, but the spectroscopic constants have been determined from the spacing of the sub-bands (groups of transitions with the same K), their intensity, the temperature coefficients of absorption and, finally, from the comparison of synthetic spectra constructed from arbitrary constants with the observed spectra. The O–N–O angle in the lower state is 154° and the N–O distance is 1·28 Å. For the excited state the angle remains essentially the same, the internuclear distance increasing to 1·41 Å. AUTHORS.

3157. Absorption spectra of gaseous methylamine and dimethylamine in the photographic infra-red. A. P. CLEAVES, H. SPONER AND L. G. BONNER. *J. Chem. Phys.*, **8**, *pp.* 784–787, *Oct.*, 1940.—The absorption spectra of gaseous methylamine and dimethylamine have been measured in the region from 6 000 to 12 000 Å using a 105 ft. stainless steel absorption tube and a 3 m. grating spectrograph. The only band showing resolvable fine structure was that at 9 940 Å in methylamine. Wherever possible, the observed bands have been assigned to overtones and combinations of the fundamental N–H and C–H valence vibrations. AUTHORS.

3158. Lattice vibrations of crystals and the corresponding vibrations of their solutions. Part II. S. FREED AND S. I. WEISSMAN. *J. Chem. Phys.*, **8**, *pp.* 840–842, *Oct.*, 1940. [See Abstract 1179 (1940).] Experiments confirm the appropriateness of the term " lattice vibrations " and analogous vibrations must be accepted as taking place in solutions. Alcohol, with a more regular arrangement within the liquid than water, gives rise to greater sharpness in the quasi-lattice vibrations of the solution. Correspondingly, a mixed solvent gives a greater spread and diffuseness to the vibrations, even though the electric fields immediately surrounding the positive ions in such a solution are as sharp in their effect on the electronic levels as in the pure solvents separately. With absolute alcohol europium chloride and europium nitrate form solutions which show different quasi-lattice vibrations in their spectra; but when these salts are dissolved in water, the vibrations of the solutions appear about the same. The hydrated crystals of europium chloride exhibit lattice vibrations which are different from those of the hydrated mixed magnesium europium nitrate. In the ionic crystals of anhydrous europium fluoride a lattice frequency appears; this is considerably greater than any yet measured. A discussion concerning the nature of the systems partaking in the quasi-lattice vibrations is included. AUTHORS.

3159. Fine structure of the 3·35μ band of ethylene. L. G. SMITH. *J. Chem. Phys.*, **8**, *pp.* 798–799, *Oct.*, 1940.—The fine structure of the parallel-type band due to the C–H stretching vibration of ethylene has been obtained with a 7 500-line grating. From the measured wave numbers of the lines of this band the mean of the 2 large moments of inertia of C_2H_4 has been determined as $30·08 \times 10^{-40}$ gm. cm^2. This value combined with the value $C = 5·70 \times 10^{-40}$ gm. cm^2. for the small moment gives for the large moments of inertia $A = 33\cdot20 \times 10^{-40}$ gm. cm². and $B = 27\cdot50 \times 10^{-40}$ gm. cm². These values are in good agreement with those previously reported. AUTHOR.

3160. Ultra-violet absorption spectra of nitrogenous heterocyclic compounds. Part II. Effect of pH and irradiation on the spectrum of barbituric acid. J. R. LOOFBOUROW AND M. M. STIMSON. *Chem. Soc., J., pp.* 1275–1277, *Sept.*, 1940.—[See Abstract 2647 (1940).] The ultra-violet absorption of barbituric acid in aqueous solution at various *p*H's changed from a maximum molecular extinction of 31 000 at *p*H 7·0 to 25 000 at *p*H 11·0 and to a minimum of 6 800 at *p*H 3, the lowest *p*H investigated. The marked change in absorption with change in *p*H is consistent with the theory that tautomerism of the amide-imidol type is responsible for the change, since 3 groups in this molecule can undergo such isomerization. The sharp peak at *p*H 7·0 indicates the additive absorption of several groups with similar absorbing characteristics. Ultra-violet irradiation resulted in a rapid progressive decrease in extinction at the 2 600 Å maximum, followed by increased absorption in the short-wave and the long-wave region of the spectrum. AUTHORS.

***3161. Simple laboratory method of producing continuous ultra-violet light.** H. N. YADAV. *Indian Journ. Phys.*, **14,** *pp.* 169–171, *April*, 1940. —A convenient method of producing hydrogen continuum from visible to 2 200 Å is described. A diagram of the arrangement and a photograph of the continuum is given.

3162. Zeeman effect of chrome alum. J. H. VAN VLECK. *J. Chem. Phys.*, **8,** *pp.* 787–789, *Oct.*, 1940.—It is shown that the Zeeman patterns observed by Spedding and Nutting are comprehensible if, and only if, the lines in question are inter-system combinations. AUTHOR.

3163. Rotational Raman scattering in liquid oxygen. B. SAHA. *Indian Journ. Phys.*, **14,** *pp.* 123–128, *April*, 1940.—The rotational wing due to liquid oxygen has been studied using a special technique to remove suspended particles from the liquid and a spectrograph capable of resolving the rotational lines of O_2 in the region of 4 046 Å. It has been found that rotational scattering does not consist of sharp lines but of a continuous wing in which the position of maximum intensity is the same as in the case of the gas, and the extent of the wing agrees with that of the rotational Raman spectrum observed in case of gaseous O_2. The significance of the results is discussed. AUTHOR.

3164. Mutual influence of water and heavy water. I. R. RAO AND Y. P. RAO. *Indian Journ. Phys.*, **14,** *pp.* 135–142, *April*, 1940.—The Raman bands of H_2O and D_2O for the pure liquids and their mixture containing equal proportions are described. The changes in the frequencies and the distribution of intensity of these bands are explained, partly on the basis of the depolymerization of these liquids in the mixture, and partly on the hypothesis of the formation of the HDO molecules. AUTHORS.

See also Abstracts **3144, 3197.**

TRANSMISSION.

3165. Transmission of infra-red radiation through fog. P. N. SMITH AND H. V. HAYES. *J.O.S.A.*, **30,** *pp.* 332–337, *Aug.*, 1940.—Data are reported for the relative transmission of radiation of various wavelengths through the atmosphere and through fog over the sea, using a radiometer as receiver. Results show that it is possible to detect and measure the energy of infra-red rays, 3μ and more in wavelength, through the worst conditions of atmosphere, and ambient illuminations to distances greater than the limits of visibility, and that a large part of the energy received from the sources used is composed of energy scattered by the fog. The receiver satisfies requirements under all conditions. N. M. B.

3166. Transmission of infra-red light by fog. J. A. Sanderson. *J.O.S.A.*, **30,** *pp.* 405–409, *Sept.*, 1940.—The transmission by 0·244 km. of foggy atmosphere has been measured in the infra-red spectrum from 1 to 12μ with a residual-ray apparatus employing quartz plates, and with an infra-red spectrometer. The transmission curves, when corrected for the transmission of the clear atmosphere, were found to be non-selective with wavelength. Author.

VISION.

3167. Measurement of sight. L. H. Hardy. *Illum. Engng., N.Y.*, **35,** *pp.* 605–624, *July*, 1940.—The author outlines the main types of measurement which have been made of the oculomotor, sensory, psychological and perceptual functions of the eye, most attention being paid to visual acuity. W. S. S.

X-RAYS.

3168. Extra spots of the Laue photograph. W. Bragg. *Nature*, **146,** *pp.* 509–511, *Oct.* 19, 1940.—A possible explanation of the diffuse spots which often appear in Laue X-ray photographs but do not belong to the Laue pattern proper is given. If a pencil of monochromatic X-rays falls on a group of regularly arranged scattering points, the diffracted rays take the form of pencils which produce a diffuse pattern such as that observed. When the group is large the diffuse pattern will be very weak, but when the group is small there will be a diffraction pattern for all positions of the crystal. The type of pattern to be expected on this theory has been calculated, and the positions of the spots agree closely with those actually observed. A. J. M.

3169. Method for obtaining powders of uniform NaCl crystals in various size ranges, and the effect of size upon the intensity of X-ray reflection. F. Marshall. *Phys. Rev.*, **58,** *pp.* 642–650, *Oct.* 1, 1940.—The crystals are prepared by precipitation with absolute ethyl alcohol from a saturated solution of NaCl in water, but varying excess quantities of water are added to either of the solutions before combining them. Control of size range, and of crystal uniformity within a size range, is accomplished by careful attention to certain primary variables in the precipitation process, each of which produces marked changes in the character of the powder obtained. These are discussed, and a simplified procedure is presented for producing any desired size. This technique was developed to make possible a study of the variation of intensity of X-ray lines reflected from such size-graded powders. The 200-reflection of Cu $K\alpha$ radiation has been investigated, and a curve is shown for the variation of intensity with crystal size. The intensity decreases slightly with increase of crystal size, according to a curve which indicates that the crystals are imperfect but are more perfect than large single crystals. Authors.

3170. Reflection of X-rays with change of frequency. Part IV. C. V. Raman and P. Nilakantan. *Indian Acad. Sci., Proc. A*, **12,** *pp.* 141–156, *Aug.*, 1940. [See Abstract 2663 (1940).]—The paper presents an experimental study and theoretical discussion of the modified reflection of X-rays in rock-salt. It is shown that the oscillation of the interpenetrating lattices of Na and Cl ions would vary the structure amplitudes of the crystal in such a way that the halved spacings which give strong unmodified reflections would also give strong modified reflections in the same order of relative intensity. This is supported by the experimental results. A geometrical construction is given for deriving the modified reflection patterns in various cases and it is shown that, for an oblique setting of the crystal, there is a remarkable similarity between the patterns and the layer-line diagram of the Bragg reflections by an oscillating crystal. The modified Bragg law $2\,d \sin \frac{1}{2}(\theta + \phi) = n\lambda$ is in very satisfactory agreement with the experimental results. AUTHORS.

3171. Comparison of the use of crystal-reflected and filtered X-rays in liquid diffraction patterns. R. Q. GREGG AND N. S. GINGRICH. *Rev. Sci. Instruments*, **11**, *pp.* 305–307, *Oct.*, 1940.—X-ray diffraction patterns of liquid Na have been obtained under different conditions of monochromatization, collimation and tube voltage. It is shown that, of the methods tried, monochromatization by rocksalt crystal reflection is the most desirable and the most expedient method, Further, an entirely spurious peak can be introduced into the pattern under certain conditions when filtered X-rays are used. AUTHORS.

3172. Secondary K-absorption spectra of sulphur. N. BAGCHI. *Indian Journ. Phys.*, **14**, *pp.* 85–88, *Aug.*, 1940.—The X-ray *K*-absorption spectrum of S shows pronounced structure extending up to an energy distance of 87 V from the main edge. The spectrum obtained shows 2 definite absorbing regions, and the intensity of some bands at large energy distance from the primary are higher than those adjacent to the main edge. The intensities of the dark and white bands do not follow any regular sequence. AUTHOR.

3173. Principal M-series emission lines of tungsten and the K absorption of Mg and Al. J. H. MUNIER, J. A. BEARDEN AND C. H. SHAW. *Phys. Rev.*, **58**, *pp.* 537–543, *Sept.* 15, 1940.—A study of the *M*-series lines of W and of the *K*-absorption edges of Mg and Al has been made by means of a double-crystal X-ray spectrometer. The extension of the double-crystal technique to these long X-ray wavelengths has been made possible by thorough evacuation of the spectrograph and a windowless X-ray tube. The crystals were the aquamarine form of beryl in which the 1010 planes have a grating constant of $8 \cdot 06$ Å. The detector was a Geiger-Müller counter with an Al window of $2 \cdot 5 \times 10^{-4}$ cm. thickness. The width and relative intensities of the prominent *M*-series W lines were measured. Accompanying the diagram lines are some 33 satellite lines. A qualitative comparison of the intensity of the continuous radiation from W with that from Al at 10 Å indicates that the ratio is less than 1, whereas theory predicts about 6. AUTHORS.

See also Abstract 3059.

HEAT.

CONDUCTION.

3174. Thermal conductivity of metals. C. C. BIDWELL. *Phys. Rev.*, **58,** *pp.* 561–564, *Sept.* 15, 1940.—As indicated in a previous paper [Abstract 206 (1929)], elementary classical considerations suggested a relation between thermal conductivity k, atomic heat C, density ρ, and absolute temperature T, of the form $k/C\rho = K/T + K'$. This is now shown to be in agreement with recent theories on the metallic state. The first term on the right relates to conduction by the crystal lattice, the second term, K', refers to conduction by electrons. It is found experimentally that K' is the conductivity in the molten condition. The present paper shows these relations for Pb, Sn and Zn. The data reported for Pb are new. A modification of the experimental method previously used for Zn was required for the work on Pb (a much poorer conductor) and is here explained. AUTHOR.

FUSION AND SOLIDIFICATION.

3175. Theory of holes in liquids. R. FÜRTH. *Phys. Soc., Proc.*, **52,** *pp.* 768–769, *Nov.*, 1940.—It is assumed that the essential difference between the structure of a solid and that of a liquid is that in the latter are a large number of small holes, of the order of magnitude of atomic radii and forming the counterpart of the atom clusters in gases or vapours. The holes are formed by the action of heat, and the frequency of the large holes increases with rise of temperature or diminution of pressure, leading, in the limit, to evaporation. The holes perform a kind of Brownian motion and so account for liquid viscosity. Methods are outlined for estimating the number and size of the holes. N. M. B.

3176. Theory of fusion. J. G. KIRKWOOD AND E. MONROE. *J. Chem. Phys.*, **8,** *pp.* 845–846, *Oct.*, 1940.

THERMOCHEMISTRY.

3177. Heats of solution of alkali halides and of hydrogen chloride in water-methyl alcohol solutions at 25°. C. M. SLANSKY. *Am. Chem. Soc., J.*, **62,** *pp.* 2430–2434, *Sept.*, 1940.—The heats of solution at infinite dilution of the chlorides of Li, Na, K, Rb, Cs and NaBr, KBr, NaI, KI and HCl, were determined in water-methyl alcohol solutions at 298·1°K. All of the compounds exhibited an appreciable maximum heat absorbed at around 15 mole % methyl alcohol, and all of them evolved more heat upon solution in absolute methyl alcohol than in water. AUTHOR.

3178. Heat of dilution of aqueous sodium hydroxide solutions at 25°. J. M. STURTEVANT. *Am. Chem. Soc., J.*, **62,** *pp.* 2276–2280, *Sept.*, 1940.—The heat of dilution of aqueous solutions of sodium hydroxide has been determined at 25° up to a concentration of 4 *m*. From these data have been calculated the apparent and partial relative molal heat content of the solute, and the partial relative molal heat content of the solvent. AUTHOR.

3179. Breaking theory of detonation. L. R. CARL. *Frank Inst., J.*, **230,** *pp.* 75–94, *July*; 207–227, *Aug., and pp.* 355–374, *Sept.*, 1940.—A theory based on present-day knowledge of crystal structure and molecular structure is proposed to account for the phenomenon of detonation. This theory assumes detonation to result from the progressive breaking of the valence bonds of compounds by distortions transmitted as elastic waves. The resulting products of detonation recombine with release of energy which maintains the wave. The sensitivity, which is the most inherent characteristic of explosives, is conditioned by the surface instability caused by surface unsaturation and by the internal instability caused by internal unsaturation (endothermic compounds). Any agency, force or quality, which protects or supports the crystal or molecule, increases its strength or tends to prevent the transmission of stresses by elastic waves, will cause the materials to be less sensitive to detonation. Materials which tend to damp out elastic waves will transmit detonation imperfectly. Detonation may be considered as a universal phenomenon since the breaking or detonation wave may penetrate any material. R. W. P.

THERMODYNAMICS.

3180. Calculation of the compositions of phases in equilibrium. G. SCATCHARD. *Am. Chem. Soc., J.*, **62,** *pp.* 2426–2429, *Sept.*, 1940.—The compositions of 2 phases of a binary system which are in equilibrium may be conveniently determined by plotting for each phase the activity, or the chemical potential, of one component against the same property of the other component, with the same standard for each state of aggregation. At equilibrium the 2 curves intersect. The corresponding compositions may be determined from an auxiliary plot of either activity or chemical potential against composition. The application of this method to several typical systems is illustrated. AUTHOR.

See also Abstracts **3087, 3198, 3199.**

VAPORIZATION AND CONDENSATION.

3181. Evaporation of water from saturated surfaces. R. W. POWELL. *Engineering*, **150,** *pp.* 238–239, *Sept.* 20, *and pp.* 278–280, *Oct.* 4, 1940. *Abridgement of paper read before the Inst. Chem. Eng., March,* 1940.—An account is given of experiments which have been carried out in an open-circuit wind tunnel to determine the rate of evaporation of water from a variety of saturated surfaces. The surfaces studied were unheated and included spheres, cylinders set transverse and parallel to the air stream, and planes set at various angles to the direction of the stream. For each type of surface it is shown to be possible to correlate the results obtained for a range of surface lengths (or diameters), l, and air speeds, u, by plotting $el/(p_w-p_a)$ against ul, where e is the rate of evaporation per unit area and (p_w-p_a) is the difference in vapour pressure between the saturated surface and the ambient air. The use of ridges for increasing the rate of evaporation from plane and cylindrical surfaces set parallel to the air stream is described. With plane surfaces it is shown that a considerable increase in the rate of evaporation from a surface facing downstream can be obtained if the plane is set at such an angle to the stream that advantage is taken of the turbulence induced by the edge of the plate. Some measurements of natural evaporation are also recorded. **Erratum,** *ibid., p.* 308, *Oct.* 18, 1940. R. W. P.

See also **Abstract 3175.**

ACOUSTICS.

3182. Symmetrical sand figures on circular plates. R. C. Colwell, J. K. Stewart and H. D. Arnett. *Acoustical Soc. of America, J.*, **12,** *pp.* 260–265, *Oct.*, 1940.—It is shown that Kirchhoff's solution for a circular plate is a special case which gives circles and diameters only. If this solution is generalized, the intricate figures actually found upon circular plates may be calculated. In particular, a few figures found by Chladni are computed from the new equations. The methods of computation from the curves of the Bessel functions are outlined. Author.

3183. Relation between velocity of sound in liquids and molecular volume. M. R. Rao. *Indian Journ Phys.*, **14,** *pp.* 109–116, *April*, 1940. —The relation $v^{1/3} \cdot V = R$ between the velocity of sound in liquids (v) and molecular volume (V) holds good in a large number of liquids. Combining this with the expression for the energy of a vibrating molecule and Debye's expression for the frequency of a vibrating molecule, it is shown that the energy of a vibrating molecule is proportional to its frequency of vibration. An expression for the variation of the velocity of sound with temperature is given and a fair estimate of the critical temperature is shown to be possible. Author.

3184. Physical analysis of distortion produced by non-linearity of medium. L. J. Black. *Acoustical Soc. of America, J.*, **12,** *pp.* 266–267, *Oct.*, 1940. [See Abstract 824 (1935).]

3185. Three mechanisms of hearing by electrical stimulation. R. C. Jones, S. S. Stevens and M. H. Lurie. *Acoustical Soc. of America, J.*, **12,** *pp.* 281–290, *Oct.*, 1940.—[See Abstract 2170 (1939).] In order to determine the relation between the hearing of normal and operated ears, 20 ears lacking tympanic membranes were stimulated electrically; 11 ears heard pure tones corresponding in pitch to the frequency of the applied voltage; 7 heard a buzzing noise whose character was roughly independent of the stimulating frequency. Examination showed that the pure-tone response in the operated ears was purely linear, in contradistinction to the quadratic response of normal ears. Hence, under electrical stimulation normal and operated ears hear by means of 2 distinctly different mechanisms. Authors.

3186. Interference of tones in the cochlea. E. G. Wever, C. W. Bray and M. Lawrence. *Acoustical Soc. of America, J.*, **12,** *pp.* 268–280, *Oct.*, 1940.

3187. Results of the World's Fair hearing tests. J. C. Steinberg, H. C. Montgomery and M. B. Gardner. *Acoustical Soc. of America, J.*, **12,** *pp.* 291–301, *Oct.*, 1940.

3188. Transmission of sound through parallel conduits. L. W. Labaw. *Acoustical Soc. of America, J.*, **12,** *pp.* 232–240, *Oct.*, 1940.—The infinite structure and the finite structure with finite termination are examined. The filter is low-pass and, by varying the cross-sections and the lengths, practically as many or as few frequencies as desired, from 0 to 10 000 c./s., can be attenuated. The effect of cylindrical and conical finite terminations is calculated and plotted. The graphs indicate that, when the length of the termination is varied so that its anti-resonance frequencies fall within attenuation bands, the transmission is very approximately that predicted from the infinite-structure study. [See Abstracts 5005 (1938) and 4637 (1939).] Author.

3189. Acoustic impedance and sound absorption. P. M. Morse, R. H. Bolt and R. L. Brown. *Acoustical Soc. of America, J.*, **12,** *pp.* 217–227, *Oct.*, 1940.—Theoretical acoustic impedance/frequency curves are compared with recently measured values of the impedance of various sound-absorbing materials. The satisfactory agreement in most cases measured indicates that for homogeneous materials the effective values of flow resistance, porosity and material density, are nearly constant over the frequency range 200 to 6 000 c./s. This makes it possible to express the whole acoustic behaviour of these materials by 3 constants. The relation between impedance and the various types of absorption coefficient is discussed, and specific formulae for the coefficients are given in terms of the acoustic impedance. In rectangular rooms, if enough scattering objects are inserted to make the diffusion of sound complete, the decay curve is a straight line with slope corresponding to the coefficient defined by Sabine. A formula relating this coefficient to the acoustic impedance is given. The Acoustical Materials Association values of absorption coefficient are compared with the curves of normal and Sabine coefficient, computed from the experimental curves for impedance. [See Abstract 3013 (1940).] Author.

3190. Absorption of sound in carbon dioxide. R. W. Leonard. *Acoustical Soc. of America, J.*, **12,** *pp.* 241–244, *Oct.*, 1940.—The absorption was measured by a direct method over frequencies between 22 and 112 kc./s. A microphone responding to the sound pressure is moved away from a piston source located in a flat surface. The output of the microphone is amplified and recorded photographically. The resulting pressure/distance curve yields the pressure attenuation coefficient. The results of the measurements bear out the theoretical work of Bourgin. In order to account for the maximal value of μ obtained experimentally, it is necessary to assume that both the symmetrical valence vibration and the deformation vibration are effective in producing the absorption, and that the second harmonic of the deformation mode also participates in the absorptive process. Velocity measurements made with the same apparatus have shown a reasonable agreement between the dispersion and absorption in carbon dioxide. [See Abstract 3834 (1932).] Author.

3191. Absorption of sound in 5 triatomic gases. E. F. Fricke. *Acoustical Soc. of America, J.*, **12,** *pp.* 245–254, *Oct.*, 1940.—The sound absorption coefficients have been measured between 8 and 130 kc./s. for CO_2, NO_2, COS, CS_2, and SO_2. The frequencies of maximal absorption for these molecules were found to be 20, 153, 287, 379 and 1 040, respectively. For the linear molecules CO_2, N_2O, COS, and CS_2 a linear relationship exists between the maximal absorption coefficients and the frequencies at which these maxima occur. The lower the fundamental frequencies of vibration of the 4 linear molecules the higher are the acoustical frequencies of maximal absorption, i.e. the shorter are the life times of the energy quanta; and the sonically activated fundamentals and harmonics of each of the above linear molecules commute and have the same life time, with the possible exception of CO_2. [See Abstract 4616 (1938).] Author.

3192. Absorption of sound in CO_2, N_2O, COS and CS_2, containing impurities. V. O. Knudsen and E. Fricke. *Acoustical Soc. of America, J.*, **12,** *pp.* 255–259, *Oct.*, 1940.—The authors have investigated the absorptive characteristics of CO_2, N_2O, COS, and CS_2 as influenced by the addition of certain gases, such as H_2, H_2O, H_2S, CH_3OH, etc., acting as "catalysts." These catalysts shift the absorption bands to higher frequencies; the magnitudes of these shifts yield information respecting (1) the frequency at which each pure gas has its maximal absorption, and (2) the nature of the molecular collisions involved, and especially the effectiveness of these collisions in disturbing the vibrational states of the absorptive molecules. **Author.**

ELECTRICITY AND MAGNETISM.

CONDUCTION AND DISCHARGE IN GASES.

3193. Electrochemistry of gases. K. G. Emeleus and J. W. Beck. *Roy. Irish Acad., Proc. A*, **46**, 5, *pp.* 49–63, *July*, 1940.—The subjects dealt with are: The formation of deposits in discharge tubes containing organic materials; the possibility of using Langmuir probes in such discharges; some wall effects in the synthesis of ammonia. The data obtained illustrate the complexity of the physical processes involved in discharges through reacting gases. It seems, however, that over a considerable range of discharge conditions the cumulative effect of electron impacts is unlikely to be important. The conditions are those of low current density and low pressure, which limit the amount of reacting material in vessels of small dimensions. The experiments give no new information as to whether the active substances formed in the discharge are neutral or charged. Among the wall effects which have been considered, the formation and breaking-down of insulating films, the formation of unstable compounds or trapping of gas at low temperature, and the effects of bombardment of ions, it is suggested that the last affords special scope for further investigation. H. H. Ho.

3194. Active nitrogen. Part I. Brightness of the after-glow under varied conditions of concentration and temperature. Part II. Incandescence of metals in active nitrogen, and quantitative estimates of the energy liberated. (Lord) Rayleigh. *Roy. Soc., Proc. A*, **176,** *pp.* 1–27, *Aug.* 28, 1940.—The integrated light emitted under the most favourable conditions was measured as 3·18 c.sec. per cm^3. of N and the number of quanta emitted is estimated as about $1\cdot3 \times 10^{-3}$ of the number of molecules present. It is concluded that the addition of unexcited N increases the (instantaneous), emission. Pressure increase produces an approximately proportional increase of brightness. Dilution by one half by diffusion into N reduces the c.p. per unit volume about 4·3-fold, but expansion to double volume into an exhausted vessel reduces the intensity 7 times instead of 8 times as expected, since compression studies show that the brightness varies as the inverse cube of the volume. Quantitative investigation of the effect of temperature shows that cooling to liquid-air temperature increases the brightness about 80 times. Assuming that the brightness is as the cube of the concentration, the brightness over the range examined varies as $T^{-0.64}$, where T is the absolute temperature. It is shown that pieces of sheet Au, Cu, Ag or Pt, may be made red hot or even melted by exposure to active N produced in a low-pressure discharge, the N giving up its energy to the metal without reacting on it. The energy of active N was measured by drawing a known quantity of gas through the discharge and then over the metal and measuring the energy liberated.

The energy was so large as to be difficult to reconcile with existing theories of the nature of active N or to account for by dissociation. The energy radiated as after-glow under favourable conditions is only of the order of 10^{-3} of the energy collected by the metal. N. M. B.

3195. Radiative detachment and attachment of the negative oxygen ion. T. Yamanouchi. *Phys. Math. Soc. Japan, Proc.*, **22,** *pp.* 569–578, *July*, 1940.—The probability of the occurrence of radiative detachment and attachment processes in the case of the O^- ion has been examined by quantum-mechanical methods. The probability of capture is very small compared with that of detachment, so that if O^- ions actually occur in the upper atmosphere, they must be produced by some other process, such as dissociation of O_2 molecules or collisions of two O atoms. A. J. M.

DIELECTRICS AND CAPACITANCE.

3196. Electric moments of morpholine and some halogenated toluenes. A. A. Maryott, M. E. Hobbs and P. M. Gross. *Am. Chem. Soc., J.*, **62,** *pp.* 2320–2324, *Sept.*, 1940.—The electric moments of morpholine, 3,5-dichlorotoluene, 3,5-dibromotoluene, 2,4,6-trichlorotoluene, 2,4,6-tribromotoluene, 3,5-dibromobenzyl bromide and *p*-chlorobenzotrichloride, have been determined in benzene solutions at 30°. Dipole induction effects between the different groups within the molecules seem to be small. The suggestion is made that the resonance affecting the halogen atoms might be altered upon the addition of other substituents in the rings so as to account for the observed discrepancies in the sym-trihalogenated toluenes and in *p*-chlorobenzotrichloride. The moment for morpholine is found to be in rough agreement with the Sachse Z-form with the possibility of a small contribution from a less polar form such as the configuration allowing an internal N- - -H–O bond. Authors.

See also Abstracts 3081, 3228.

ELECTROCHEMISTRY.

3197. Electrolytic dissociation in H_2SO_4 as studied by Raman effect. N. R. Rao. *Indian Journ. Phys.*, **14,** *pp.* 143–151, *April*, 1940.—The Raman spectrum of H_2SO_4 and its salts at different concentrations is studied, and the changes with dilution in the intensity of the lines observed in the spectra are made use of to study the electrolytic dissociation of the acid. An observation made by I. R. and C. S. Rao, that the alkali salts are completely dissociated even in concentrated solutions, is made use of to calculate the absolute degree of dissociation of the acid. On calculating the number of dissociated and undissociated molecules in solutions of the acid and $KHSO_4$, it is observed that (1) the rate of dissociation of the acid is less in dilute solutions than in moderately concentrated solutions, (2) in equimolecular solutions of sulphuric acid and acid sulphate the dissociation of HSO_4 molecules is greater in acid sulphate than in the acid. The above results are explained as due to the fact that in the solutions of the acid there is a larger abundance of H-ions than in the acid salt, which favour the formation of more HSO_4 ions in the acid. Author.

3198. Application of e.m.f. measurements to binary metal systems. H. Seltz. *Electrochem. Soc., Trans.*, **77,** *pp.* 233–257; *Disc.*, 257–259, 1940.—Electrometric studies of the lower-melting metal systems of Pb-Bi, Cd-Sb and Zn-Sb have been carried out to obtain data for the development of a satisfactory theory of metallic solutions. It is shown how the thermodynamic properties of the solution can be evaluated from e.m.f. measurements, and the thermodynamic data now obtained are applied to the calculation of phase equilibria, entropies, free energies and heats of formation, of any intermetallic compounds which may occur. The measurements were carried out in specially designed pyrex H-cells, and the electrolyte was a fused eutectic mixture of KCl (56%) and LiCl to which was added 2–5% of the chloride of the more electropositive metal; it was found possible to extend the measurements up to 635°C. Accurate equilibrium diagrams are established, and in the discussion it was remarked as noteworthy that the relationship between e.m.f. and temperature is almost exactly linear, which requires that the heat effects and entropy must be independent of temperature and a function of composition only. H. H. Ho.

3199. Thermodynamics of the silver bromide/mercurous bromide cell. T. W. Dakin and D. T. Ewing. *Am. Chem. Soc., J.*, **62,** *pp.* 2280–2284, *Sept.*, 1940.—The standard electrode potential of the mercurous bromide electrode has been evaluated over the temperature range 15–35° by reference to the better established value for the standard potential of the silver bromide electrode and has been found to be 0·139 25 V at 25°. The free energy of formation of mercurous bromide has been found to be −42 733 cal./mole, the heat of formation − 48 776 cal./mole, and the entropy of formation − 20·4 cal./deg./mole, while the standard entropy of Hg_2Br_2 is calculated to be 53·4 cal./deg./mole, all values being at 25°. The potential and free energy values are not seriously different from the values given either by Ishikawa and Ueda or by Larson but, whereas agreement is maintained with entropy and heat values obtained by Ishikawa or by Ueda who measured the temperature coefficient of a different cell, disagreement is found with entropy and heat values obtained by Larson. Authors.

3200. Mechanism of the hydrogen electrode process. A. Frumkin. *Inst. Phys. and Chem. Research, Tokyo, Sci. Papers, No.* 981, *pp.* 473–477, *July*, 1940.—The author criticizes a recent paper by Hirota and Horiuti [Abstract 2697 (1940)] with respect to the metals Hg, Ni, and Pt. In the case of Hg it is found that Horiuti's theory will not explain the data, for Ni the discrepancy between the data of Horiuti and the author may be due to different pre-treatments of the Ni surface, and for Pt the author dissents from the assumption of a molecular hydrogen ion H–H on the surface of the Pt electrode. It is pointed out that hydrogen ions in the double layer of the latter electrode are readily exchanged against other cations, a behaviour which would be very difficult to explain if these ions were present in the form of H_2^+ ions. H. H. Ho.

3201. Rate of solution of metals in acids as a function of overvoltage. Parts I and II. G. E. Kimball and A. Glassner. *J. Chem. Phys.*, **8,** *pp.* 815–827, *Oct.*, 1940.—The problem of simultaneous conduction and diffusion through a constrained diffusion layer is discussed. An exact solution is obtained for the case of an ideal dilute solution containing only 2 ionic species. The special case of divalent ions diffusing into a uni-divalent electrolyte is also solved by numerical methods. It is shown that for diffusion layers of thicknesses of the order of 50μ the potential drop across the layer for currents of the order of magnitude of 100 mA/cm^2. is less than 1 mV. It is therefore legitimate to neglect the diffusion potential in comparison with the double-layer potential at an electrode surface.

The rate of solution of Cd in H_2SO_4 has been measured as a function of the hydrogen overvoltage at the electrode surface. The rate was found to be constant at a given potential, independent of the concentration of H_2SO_4 used. The rate increases with the electrode potential in accordance with the theory of Kimball. From the dependence of the rate on the speed of stirring, and also from the behaviour on varying the potential, it is concluded that the solution process is diffusion-controlled. AUTHORS.

ELECTRONS, NEUTRONS, POSITRONS AND PROTONS.

3202. Capture cross-sections for thermal-energy neutrons. C. LAPOINTE AND F. RASETTI. *Phys. Rev.*, **58**, *pp.* 554–556, *Sept.* 15, 1940.—Cross-sections for capture of thermal-energy neutrons were measured for several elements. The method consisted in comparing, by a BF_3 ionization chamber, the density of thermal neutrons in water and in a solution of the element investigated. In order to avoid corrections for geometry the effect of the substance was compared with that of B-solutions of different concentrations, and the measurements give the ratio of the cross-sections of the elements investigated to the cross-section of B. Data are given for N, F, Na, P, Cl, K, V, Mn, Co, As, Se, Br, Cd, I, Ba. AUTHORS.

3203. Interpretation of resonances in nuclear reactions. G. BREIT. *Phys. Rev.*, **58**, *pp.* 506–537, *Sept.* 15, 1940.—The theory of resonances in the 1-body problem model is systematized. Energy shifts in the apparent position of levels are found. The apparent position of levels in scattering and in γ-ray emission is expected to be the same to within Γ^2/E in the usual notation if the only repulsive barrier is the centrifugal one. In the absence of strong repulsive barriers there may be additional shifts of the order Γ. Interference between levels is shown to occur for the scattering cross-section in the numerator and the denominator of a fraction. The artificiality of usual formulae with interference for cross-sections is discussed in this connection. The construction of Green's function for 2-dimensional separable problems is described. The construction works also for some many-dimensional problems. The reduction of the number of essential dimensions is outlined by a reformulation of the problem in 1 less dimension. Applications are made to the solution of scattering problems which represent schematically idealized nuclear problems. A simplification occurs if the interaction is highly repulsive and is localized in the 2-dimensional space of the distances of the particles from the centre. In this case the regular functions f for the incident and final state enter linearly in the wave function. If the interaction region is made large and if the incident state happens to be especially important in the expansion of Green's function, the factor g of the incident wave occurs in the formula for the cross section. A resonance model is worked out by assuming the interaction to be highly attractive within a circle and repulsive in a ring surrounding the circle in the 2-dimensional diagram. The damping constants in the resultant formula contain f^2. Here also the single dependence on f^2 is a consequence of having localized the interaction to a narrowly defined radius for the incident particle. In the general case each damping constant involves the g of different states. The examples show that quantitative applications with simplified forms of damping constants and with interference types of dispersion formulae have only a limited validity. AUTHOR.

3204. Angular distribution in the reaction F^{19} (p, α). E. GERJUOY. *Phys. Rev.*, **58,** *pp.* 503–505, *Sept.* 15, 1940.—The angular distribution of the long-range α-particles shows marked lack of spherical symmetry, with asymmetry in the forward and backward directions. The distribution is constant with bombarding energy in the range 330 to 435 ekV and contains large $\cos\theta$ and $\cos^2\theta$ terms with somewhat smaller and less certain amounts of the 3rd and 4th powers. It is shown that the energy dependence implies broad levels and constant penetrabilities; the latter is found to agree with calculation. The experimental distributions can most simply be accounted for by the assumption that the chief contributions are from 3 levels of total angular momentum $J = 0,1,2$. This leads to the experimental curves without arbitrary assumptions of the values of the line breadths or detailed assumptions about the nuclear coupling scheme. Powers of $\cos\theta$ higher than the 4th in the angular distribution are not to be expected. AUTHOR.

3205. Distribution in angle of the long-range α-particles from F bombarded with protons. W. B. MCLEAN, A. ELLETT AND J. A. JACOBS. *Phys. Rev.*, **58,** *pp.* 500–502, *Sept.* 15, 1940.—The distribution in angle of the long α-particles from the reaction $F^{19} + H^1 \rightarrow O^{16} + He^4$ has been determined at bombarding energies of 330, 375 and 435 ekV. This distribution shows a very strong fore and aft asymmetry which varies only slightly with the bombarding voltage. The distribution is well represented by the expression $1 + 0{\cdot}66\cos\theta + 0{\cdot}25\cos^2\theta + 0{\cdot}41\cos^3\theta$. AUTHORS.

3206. Distribution in angle of α-particles from Li bombarded with protons. V. J. YOUNG, A. ELLETT AND G. J. PLAIN. *Phys. Rev.*, **58,** *pp.* 498–500, *Sept.* 15, 1940.—The distribution in angle of α-particles from $Li^7 + H^1$ is found to be of the form $1 + A\cos^2\theta$. The variation of A with bombarding energy is characterized by a rapid increase in the range 250 to 325 ekV, presumably indicating resonance to a broad excited level of Be^8. AUTHORS.

3207. Angular distribution of fast neutrons scattered by hydrogen, deuterium and helium. H. H. BARSCHALL AND M. H. KANNER. *Phys. Rev.*, **58,** *pp.* 590–596, *Oct.* 1, 1940.—The angular distribution was measured by observing the distribution in energy of the recoil particles in an ionization chamber. The scattering in hydrogen and deuterium was found to be essentially isotropic in the angular interval investigated. In helium collisions with small energy transfer were more frequent than large-angle scattering. The absolute differential scattering cross-section of helium was measured. AUTHORS.

3208. Scattering of fast electrons in helium. J. B. H. KUPER AND E. TELLER. *Phys. Rev.*, **58,** *pp.* 602–603, *Oct.* 1, 1940.—Failure of the quantum-mechanical theory of elastic scattering to account for experimental results of Kuper on scattering of 50 kV to 80 electrons in He has been explained by neglect of the inelastic scattering. Computation of the cross-sections including inelastic as well as elastic collisions by an approximate method yields satisfactory agreement without requiring any modification of the theory. AUTHOR.

3209. Electron scattering in bromine gas. C. H. SHAW AND T. M. SNYDER. *Phys. Rev.*, **58,** *pp.* 600–602, *Oct.* 1, 1940.—Calculations have been made on the angular dependence of electron scattering in bromine gas with the scattering phases obtained in a recent paper [Abstract 2166 (1940)]. For the lower energies it is essential that atomic polarization be included in the calculations of the phase defects. The results are compared with previous experimental work by Arnot. AUTHORS.

3210. Secondary emission from films of platinum on aluminium. P. L. Copeland. *Phys. Rev.*, **58,** *pp.* 604–607, *Oct.* 1, 1940.—Experimental results indicate a direct proportionality between the primary energy (up to 800 eV) and the maximum depth from which the secondaries come. The depths of origin of secondaries as indicated by these studies are not out of line with those which would be expected on the basis of existing theories. The maximum depth within the target influencing the secondary emission increases more rapidly for primary energies above 800 eV than for those below. Author.

3211. Relative secondary electron emission due to He, Ne, and A ions bombarding a hot nickel target. M. Healea and C. Houtermans. *Phys. Rev.*, **58,** *pp.* 608–610, *Oct.* 1, 1940.—The number of electrons emitted per positive ion from a degassed Ni target bombarded by He, Ne, and A ions was measured. For He in an energy range from 450 to 1 650 eV the emission increased from 49 to 107% ; for Ne having energies from 900 to 1 275 eV the increase was 43 to 57% ; for A of 680 to 1 480 eV from 11 to 18%. These results confirmed those found earlier for H_2^+ and D_2^+ ions in showing a smaller emission for the heavier ion at the same energy. Similarly, the percentage of positive ions reflected increased with the energy of the primary ions and was smaller for the heavier ions. Authors.

3212. Cloud-chamber studies of fission fragment tracks. K. J. Brostrøm, J. K. Bøggild and T. Lauritsen. *Phys. Rev.*, **58,** *pp.* 651–653, *Oct.* 1, 1940.

3213. Scattering and stopping of fission fragments. N. Bohr. *Phys. Rev.*, **58,** *pp.* 654–655, *Oct.* 1, 1940.

3214. Lateral diffusion of a stream of ions in a gas. L. G. H. Huxley. *Phil. Mag.*, **30,** *pp.* 396–413, *Nov.*, 1940.—The problem of determining theoretically the spatial distribution of ions or of electrons streaming in a steady state of motion through a gas under the action of a uniform electric field is of considerable practical importance. It is generally solved by employing the standard methods of the theory of the conduction of heat and of diffusion, but in general the solutions appear in series form, and the labour of computing the distribution of the stream over a receiving electrode may be very considerable, although in special circumstances simplifications can be introduced. In this paper an alternative analysis is presented, which affords solutions in a more convenient form, and leads to some generalizations of theory. The more important cases encountered in practice are discussed, and the paper includes a section on the effects of magnetic fields. Author.

3215. Steady-state diffusion under conditions of generalized source and incident current distributions. E. A. Schuchard and E. A. Uehling. *Phys. Rev.*, **58,** *pp.* 611–623, *Oct.* 1, 1940.—The method of Laplace transformations is extended to the more general case of neutron diffusion in half-infinite media containing source distributions, and an exact expression for the emergent current distribution is obtained. This expression depends on the total m.f.p., on the ratio N of the capture to scattering m.f.p. and on the type of source distribution. For a uniform source distribution and with N sufficiently large, the values of the normalized current as a function of angle agree closely with those given by the Fermi law. More significant discrepancies between the results of elementary theories and the exact theory are to be found in the ratio R of detector activities corresponding to positions deep within the medium and at the surface. The exact theory gives $R = (N + 1)^{1/2} + 1$ for uniform source distributions. A recent quotation of $R = 14$ for the case of thermal neutron diffusion in paraffin then implies $N = 168$ instead of 196 as given by the elementary theory. AUTHORS.

*3216. **Magnet lens for β-rays of high energy.** V. E. COSSLETT. *Journ. Sci. Instruments,* **17,** *pp.* 259–264, *Nov.,* 1940.—A magnetic electron lens has been constructed of much greater focusing efficiency than hitherto available. It provides fields capable of focusing 15 eMV electrons at a focal length of 37·5 cm. Its performance has been tested up to an electron energy of 3·2 eMV, and it was used to investigate the supposed emission of β-rays of very high energy from Li under neutron bombardment, with negative results. Optimum conditions for its use as a β-ray spectrometer are discussed. AUTHOR.

See also Abstract 3130.

MAGNETISM AND ELECTROMAGNETISM.

3217. **Theoretical magnetic susceptibilities of metallic lithium and sodium.** J. B. SAMPSON AND F. SEITZ. *Phys. Rev.,* **58,** *pp.* 633–639, *Oct.* 1, 1940.—The magnetic susceptibilities of metallic Li and Na are computed by using the best available theoretical information. Bardeen's effective masses and exchange and correlation terms are included. This procedure appreciably affects the theoretical paramagnetism for free electrons, giving results considerably different from those obtained from Pauli's equation with the assumption that the electrons are perfectly free and that exchange and correlation terms may be neglected. The final computed susceptibility for Na is close to the observed value, but that for Li is about twice the highest experimental one. The possible sources of error are investigated, and it is concluded that the presence of a quartic term in the expansion of the 1-electron energy parameter in terms of a power series in the electron wave number would be sufficient to account for the deviation. The level density curves obtained from X-ray emission curves are discussed, and it is concluded that all details of these curves cannot be explained on the basis of the simple picture ordinarily used. AUTHORS.

3218. **Theory of anti-ferromagnetism.** S. MIYAHARA. *Phys. Math. Soc., Japan, Proc.,* **22,** *pp.* 528–530, *July,* 1940. *In German.*—Some substances lately discovered show ordinary paramagnetism at high temperatures, but at a definite temperature behave as ferromagnetic substances exhibiting a marked increase and at lower temperatures a decrease of susceptibility. The susceptibility/temperature curve thus shows an A-shaped bulge. This peculiar characteristic is called antiferromagnetism. The author discusses a theory of the phenomenon on the lines of semi-conductivity. J. J. S.

3219. **Interpretation of ferromagnetic colloid patterns on ferromagnetic crystal surfaces.** W. C. ELMORE. *Phys. Rev.,* **58,** *pp.* 640–642, *Oct.* 1, 1940.—It is shown that the bodily motion of particles rather than a magneto-optic effect is chiefly responsible for field-induced changes in ferromagnetic colloid patterns on ferromagnetic crystal surfaces. A simple relation between colloid concentration and magnetic field intensity near the crystal surface is deduced from the Boltzmann distribution law. Several implications of this relation are discussed, including the rôle played by magnetic interaction of the particles. The formation of elongated chains of particles in a colloid placed in a magnetic field is shown to be unlikely, provided that the particles are sufficiently small in size. AUTHOR.

3220. Magnetic susceptibilities of solutions of $NaNO_3$ and KNO_3. S. P. Ranganadham and M. Qureshi. *Indian Journ. Phys.*, **14**, *pp.* 129–134, *April*, 1940.—Diamagnetic susceptibilities of solutions of $NaNO_3$ and KNO_3 have been determined over a wide range of concentration (1 to 20%) employing a modified form of Quinke's method with a photographic recording arrangement. The susceptibility/concentration graph is in each case a straight line cutting the susceptibility axis at a point corresponding to the susceptibility of pure water ($-0{\cdot}72 \times 10^{-6}$), the maximum departure from linearity being not more than 1%. The gram-ionic susceptibility of NO_3^- calculated from these measurements, using the theoretically calculated values for Na^+ and K^+, is different in each case, being less for the potassium salt. In view of the fact that there is a lack of agreement between the values for Na^+ and K^+ arrived at by different workers and the theoretical values calculated by different methods, no definite conclusion can be drawn with regard to the specific influence of the positive ion. It is, however, clear that the experimental values are, on the whole, much less than the theoretical value for NO_3^-, which is an indication of ionic deformation. Authors.

3221. Self-consistent fields and diamagnetic susceptibility for magnesium III. W. J. Yost. *Phys. Rev.*, **58**, *pp.* 557–560, *Sept.* 15, 1940.—Self-consistent fields, both with and without exchange, have been calculated for doubly ionized Mg in the normal state. All of the equations have been solved numerically with the aid of an electrical calculating machine. The Z_0 functions have been tabulated along with the corresponding P functions in each case. The former functions do not differ by more than $\pm 0{\cdot}003$ at any point in the 2 last stages of the work. The diamagnetic susceptibility has been calculated, yielding the value: $-3{\cdot}74 \times 10^{-6}$. Author.

3222. Recent experiments on the biologic effects of magnetic fields. M. Lenzi. *Radiology*, **34**, *pp.* 307–314, *Sept.*, 1940.—Published work on this subject shows contradictory results and the present work attempts to clear up discrepancies. The experimental work has been carried out with an electromagnet supplied with various low frequencies and with d.c., producing fields up to 1 700 gauss. White mice were used and various biologic tests carried out; results are given. It is considered that the different effects with a.c. as compared with d.c. are due to induced currents in the tissues. Further work is in progress. E. H. W. B.

MEDICAL RADIOLOGY AND ELECTROLOGY.

3223. Use of fast neutrons in the treatment of malignant disease. R. S. Stone, J. H. Lawrence and P. C. Aebersold. *Radiology*, **34**, *pp.* 322–327; *Disc.*, 327, *Sept.*, 1940.

3224. Geometrical methods of projecting dose contours. C. W. Wilson. *Brit. J. of Radiology*, **13**, *pp.* 345–350, *Oct.*, 1940.—In order to determine the complete 3-dimensional distribution of radiation throughout a volume of irradiated tissue it is necessary to deduce the distribution in any plane due to a single beam of radiation. This can be done by means of a projection on to the desired plane of the experimentally determined dose contours in the principal plane of the beam, i.e. the plane containing the central axis. In the method described this projection is carried out by simple geometrical means, the only apparatus required being ordinary drawing instruments. Examples are given of the determination of the dose distribution in planes at various depths and inclined at various angles to the central axis of the beam of a teleradium unit. The method is applicable to any symmetrical radiation distribution. J. E. R.

***3225. Electrical integrator for "action currents".** G. L. FREEMAN AND E. L. HOFFMAN. *Rev. Sci. Instruments,* **11,** *pp.* 283–284, *Sept.,* 1940.—An apparatus is described for integrating bio-electric potentials over various time intervals. This is accomplished by recording the number of times a gas-filled tube discharges a condenser which stores the rectified potentials. AUTHORS.

3226. Formal theory of nerve conduction. A. M. WEINBERG. *Math. Biophysics, Bull.,* **2,** *pp.* 127–133, *Sept.,* 1940.—A general solution of the formal nerve conduction problem is given. As illustrations of the general method, the capacitive single-factor and the non-capacitive Lapicque problems are solved. Comparisons between velocity formulae for capacitive and non-capacitive models indicate that previously determined non-capacitive velocities are considerably too high. AUTHOR.

OSCILLATIONS AND WAVES.

3227. Propagation of electromagnetic waves in an ionized medium and the calculation of the true heights of the ionized layers of the atmosphere. O. RYDBECK. *Phil. Mag.,* **30,** *pp.* 282–293, *Oct.,* 1940.—The equation of propagation of the waves can be regarded as a Schrödinger equation for the motion of a wave packet in a potential field if the electromagnetic waves are short. The interpretation holds up to the classical level of reflection at vertical incidence. Under these conditions the heights of the ionized layers are calculated as well as the electron density in the layers. G. C. McV.

PIEZO-ELECTRICITY.

3228. Properties of Rochelle salt. Part III. H. MUELLER. *Phys. Rev.,* **58,** *pp.* 565–573, *Sept.* 15, 1940.—The interaction theory of Rochelle salt is extended by supplementing the expression for the free energy of the deformed and polarized crystal by a term proportional to the 4th power of the polarization in the *a* direction. This second approximation explains the dielectric and elastic saturation phenomena above the upper Curie point and the dielectric, elastic, piezo-electric and pyro-electric properties in the ferro-electric temperature range. All experimental results are compatible with the hypothesis that the clamped crystal has only 1 transition point at about 5°C., where its dielectric constant has a very high maximum. The 2 Curie points of the free crystal are due to the interaction between the elastic deformation and the electric polarization. Instead of sudden changes of the heat capacity the new theory predicts slight changes of the slope of the specific-heat curve at the Curie points. The dispersion of the dielectric constant is explained without assuming a relaxation time. [See Abstract 1987 (1940).] AUTHOR.

THERMO-ELECTRICITY.

3229. Temperature dependence of the work function of tungsten from measurement of contact potentials by the Kelvin method. J. G. POTTER. *Phys. Rev.,* **58,** *pp.* 623–632, *Oct.* 1, 1940.—The Kelvin method for the determination of contact potentials is adapted for measurements between filaments in vacuum. Measurements between a heated and a cool tungsten filament indicate an increase in the work function of tungsten with temperature, of $6 \cdot 3 \times 10^{-5}$ V/deg.C. This effect is distinguished from changes in work function arising from variations in contaminating layers on the tungsten with temperature, which tend to obscure the true temperature coefficient even under the best vacuum conditions. The observed true temperature coefficient appears to be comparatively independent of the existing degree of surface contamination. This suggests that the temperature effect must reside primarily in the thermodynamic potential of the electrons inside the metal and not in the potential barrier at the surface. The coefficient obtained resolves the discrepancy between the experimental value of A in the Richardson equation and the theoretical factor of 120 without the introduction of a reflection coefficient. AUTHOR.

***3230. Calibration of thermocouples at low temperatures.** R. B. SCOTT. *Bureau of Standards, J. of Research*, **25**, *pp*. 459–474, *Oct.*, 1940.—Descriptions are given of apparatus and methods used at the National Bureau of Standards for the calibration of thermocouples between 0° and − 190°C. Descriptions are given of (1) a cryostat for maintaining very constant temperatures in the range 0°C. to − 170°C.; (2) a convenient and accurate procedure for the realization of the equilibrium sublimation temperature of commercial solid CO_2; (3) a method of preparing pure oxygen for vapour-pressure thermometers, and (4) an improved apparatus for calibrating resistance thermometers and thermocouples at the oxygen boiling point. A reference table for copper-constantan thermocouples is given. Curves are shown representing the deviations from the table of a number of thermocouples calibrated at the Bureau. These curves, which represent the behaviour of a number of thermocouples from different sources, constitute the basis for a discussion of the relation between the accuracy obtainable with a copper-constantan thermocouple and the number and positions of the calibration points. AUTHOR.